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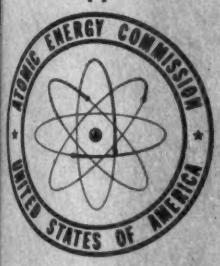
Nuclear Science Abstracts

NEW NUCLEAR DATA

1956 CUMULATION

Volume 10 No. 24B
December 31, 1956



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NEW NUCLEAR DATA

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Table 1. Radioactivity, Levels, Abundances, Moments
Table 2. Neutron Cross Sections
Table 3. Ground State Q's
Table 4. Mass Differences
Table 5. Nuclear Spins and Moments

INTRODUCTION

This issue of Nuclear Science Abstracts, Volume 10, No. 24B, contains the fifth annual cumulation of new nuclear data. The results collected here have been taken from journals which have become available from about October 1955 to October 1956. As the list of the specific journals abstracted, which is given below shows, the coverage in this cumulation begins where it left off for the 1955 list.

Earlier 1956 nuclear data summaries have been published in Nuclear Science Abstracts, Volume 10, No. 12B (June 30, semiannual cumulation) and No. 18B (September 30). These summaries, together with the material which came to hand since 18B was prepared, are included in the present one.

The 1952, 1953, 1954, and 1955 annual cumulations are contained in issues 24B of Vols. 6, 7, 8, and 9 respectively. The supply of extra copies for 1952, 1953, and 1954 is exhausted; for 1955 copies are obtainable for $0.60 from the Superintendent of Documents, U. S. Government Print-

ing Office, Washington 25, D. C. Remittance should be by check or money order. Add 25% for foreign postage.

New Table of Data on Nuclear Spins and Moments: The present cumulation contains for the first time a separate list, Table 5, of the new data on nuclear spins, magnetic, and electric moments. Although these data are also to be found in Table 1, they have been made into a separate collection for the benefit of those particularly interested in the field of moments. The Neutron Cross Sections and the Mass Differences which are given in Tables 2 and 4 are not included in Table 1, since this table is devoted chiefly to information on the properties of nuclear levels. Ground State Q's are given in Table 1 when they are reported in a paper dealing with level properties. However, for complete information on new measurements of ground state Q's, the reader should consult Table 3.

Nuclear Data Cards: As the current literature is surveyed, the new nuclear results are first printed on 3-by-5-inch cards which are collected into sets of about 150 cards each month. Individuals, laboratories, or libraries may subscribe to the card sets directly by applying to the Publications Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

Due to the response to this service it has been possible to reduce the subscription charges to the following: U. S. and Canada $15 (1st class postage), formerly $20; elsewhere $15 (printed matter postage) or $19 (1st class postage), formerly $30 airmail. Airmail rates on request.

Nuclear Level Schemes: The first section of a new comprehensive nuclear data table prepared by the Nuclear Data Group was published late in 1955 by the Government Printing Office. The aim of Nuclear Level Schemes is to provide a revision and expansion of Nuclear Data which was issued in 1950 as Circular 499 of the U. S. National Bureau of Standards. It will be published in five or six sections, each one of which will be issued upon completion. The first section, now available gives the data for known nuclei with mass numbers between A = 40 and A = 92, thus covering roughly the elements $_{20}$Ca through $_{40}$Zr. The second section will summarize the information for the next 20 elements, the third for 20 more, and so on.

The style of presenting data in Nuclear Level Schemes is very similar to that used on the Nuclear Data Cards and in the cumulated lists of Nuclear Science Abstracts. The cards, or the lists, will thus provide a convenient means of keeping this table up to date.

Nuclear Level Schemes (A = 40 to A = 92), TID-5300, can be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.75, 240 pages paperbound. Remittance should be by check or money order. Add 25% for foreign postage.

NUCLEAR DATA STATISTICS

Just below some numbers are given to show the amount of new nuclear data in 1956 compared to that in previous years. The periods referred to as 1955, 1956 etc. are twelve month periods beginning each year at about Oct. 1st. By an "item" is meant the information on a particular nucleus given with its reference in the main section, Table 1, of the cumulation which covers Radioactivity, Levels, Abundances, Moments.

	Number of Items on Radioactivity etc.	Number of Cross Sections	Number of Ground State Q's	Number of Mass Differences	Number of Nuclear Moments	Number of New Nuclei Reported	Total NSA Pages
1952*	1186	264	205	139	99		52
1953	1026	562	140	133	60		74
1954	1328	308	107	112	79		99
1955	1581	425	107	18	84	67	141
1956	1534	433	133	106	75	39	144

*15 months.

SOME 1956 HIGHLIGHTS

Expressions of interest in our list of 1955 "Highlights" have prompted us to make a similar collection for 1956. We realize, of course, choices for any such list depend in a highly personal way on the particular interests and enthusiasms of the authors. It is in the spirit of trying to make the following large collection of data more interesting rather than of awarding special praise that these comments are made. In many cases it seemed cumbersome to repeat here the names of the authors of all the experimental work cited. These names together with complete literature references are given in the data tables under the relevant nuclei. References to theoretical papers mentioned are given at the end of the "Highlights."

Although the neutrino does not really belong to the nuclear family, data on its properties have consistently been noted in these cumulations because of its importance in the fundamental concepts of β decay. Its existence was finally definitely established during the year as the result of a series of unusually difficult and large scale experiments carried out by Cowan and Reines which demonstrated the existence of the reaction $H^1(\nu,e^+)n$. The observation of 2.88 ± 0.22 counts per hour due to delayed coincidences between annihilation γ's and the γ rays from neutron capture made it possible to determine the reaction cross section as $\sim 10^{-19}$ barns for fission product neutrinos. Another experiment also completed this year showed that the cross section for the reaction Cl^{37} $(\nu,e^-)A^{37}$ for fission product neutrinos is $< 0.9 \times 10^{-21}$ barns. This latter result suggests that fission product neutrinos are actually antineutrinos and that these are different from the neutrinos required for the Cl^{37} reaction. The large lower limits found for the lifetimes in the double β decay of Ca^{48} ($>2 \times 10^{18}$y) and Zr^{96}($>5 \times 10^{17}$y) also suggest that neutrinos and antineutrinos are different.

The antiproton[1] and the antineutron[2] were discovered within recent months. These particles may play an important role in nuclear physics, but as far as low energy nuclear physics is concerned, they appear only in virtual processes. For this reason we have not included them in the nuclear family of our tables.

A great deal of work continues to be reported on the positions and spins of low-lying levels since these are important for testing nuclear models. In the very light region the detailed theoretical calculations of Kurath[3] and Lane[4] on intermediate coupling, the α-particle model results as summarized by Inglis[5] and the shell model computations of Elliott and Flowers[6] and of Redlich[7] for nuclei just above O^{16} offer definite predictions for experimental verification. There are not yet sufficient data to make possible a general statement about any of these models but some points of interest are noted.

In the matter of a possible level in He^4 at ~ 22 Mev which might be expected on a shell picture, it has been shown by the 1956 data that there definitely are maxima (at points corresponding to a level at this energy) in the cross section curve for $H^3(p,n)$ and in the total neutron cross section of He^3. However, no trace of such a level is to be found by He(p,p') for proton energies of 28 and 40 Mev. Selove[8] has pointed out that the $H^3(p,n)$ results can be accounted for by the direct interaction picture.

Neither the α-particle model nor the intermediate-coupling picture predicts levels in Be^8 between ground and ~ 9 Mev other than the well known state at 2.9 Mev. During the year results of careful studies were made of the reactions $Li^7(p,\gamma)$, $Li^6(He^3,p)$, and $B^{10}(d,\alpha)$ and no evidence of an additional level found. However, results from a careful experiment by $Be^9(d,t)$ show a possible level at 2.2. Several levels were reported by $C^{12}(\gamma,\alpha)$ and $Li^7(d,n)$ but the methods necessarily used for studying these reactions cannot claim the good statistics of those used with the previously mentioned processes.

The number and character of the low-lying states in Be^9 and B^9, which are important for testing the intermediate coupling model, are not yet settled. The model predicts two low-lying odd-parity states while the data show that possibly there are three such levels in Be^9.

A new and unpredicted level has been reported in B^{10} by Li^7 (α,n).

A search for a possible low-lying isomeric level in N^{16} of approximately the same lifetime as the ground state brought negative results.

A level at 8.87 Mev in O^{16} has been shown to have a spin-parity of 2^-. Such a level cannot be accounted for by the alpha-particle model.

Careful measurements on the β^+ branching in O^{14} and the 2.31-Mev γ-ray lifetime in N^{14} support the hypothesis that the long lifetime of C^{14} is due to accidental cancellation in the matrix element for the decay.

Shell-model predictions for states in O^{18} between 1.9 and 3.5[6,7] do not seem to be fulfilled although a number of nuclear properties in the region A = 17 to A = 19 are fairly well accounted for. A great deal of work has gone into the level structure of F^{19} during the past year. There are now altogether three low-lying levels not predicted by the model but the question as to whether

they are all of negative parity, and therefore not to be expected from the current calculations, has not yet been settled.

As pointed out by Wilkinson,[9] El and Ml transitions in the light nuclei can be reasonably well accounted for by the shell model. (All couplings give about the same result). The transitions are all slower than the single-particle expectations. However, for higher multipoles some transitions faster than predicted by a single-particle model have been found. These suggest some type of collective motion even for nuclei composed of a small number of particles. The technique of measuring such lifetimes by the study of the Doppler shifts is increasing the amount of data in this field.

Two other new techniques which are providing new data in the regions of both light and heavy elements consist of He^3 bombardment and "neutron threshold" detection. He^3 beams are being used now at Chalk River, Naval Research, Oak Ridge, Rice Institute, and possibly elsewhere. Reaction mechanisms are being investigated and products studied. By observing the ratio of slow to fast neutrons in a BF_3 and "long counter" respectively, the Rice Institute group has developed a powerful method for the study of reactions which result in neutron emission. Techniques similar to this are also being used by other groups.

Extensive studies of the levels in Al^{25} and Al^{26} have been made by means of the (p,γ) reaction. The Chalk River group, who investigated Al^{25}, have pointed out that the level scheme of this nucleus can be well explained by the collective model. This is a very surprising result for a nucleus as light as Al^{25}.

In the region $A \sim 30$, the energies of many levels were precisely determined during the year by means of charged particle reactions such as (p,p'), (d,p), (p,α), and (d,α). One hundred levels in Al^{28} have been established by the (d,p) reaction.

The 0.69 Mev level in P^{30} has been considered to be a $T = 1$ state. Studies of the (p,γ) reaction supported this interpretation. However, recently a high yield of this level from (d,α) has been noted. This casts some doubt on the $T = 1$ assumption since only $T = 0$ levels are expected from this reaction.

Detection of $\gamma^{\pm}$ from P^{32} in a very careful experiment gave the first reliable positive evidence for internal pair creation accompanying β decay. This result does not settle the question of the existence of a new positive particle, other than the positron, which has been suggested by some studies of the P^{32} decay.

A new geological determination of the ratio of electron capture to β decay in K^{40} by the measurement of the A^{40} present in minerals of known ages gives a value (0.117 ± 0.015) considerably higher than before. The result is in reasonable agreement with that found from counting methods (0.124 ± 0.002).

Spins of Co^{56} and Co^{60} were measured by the paramagnetic resonance method, which gave 4 and 5 respectively. Precise values of $|\mu|$ were also obtained for these two nuclei by the same method. Previous values of $|\mu|$ measured by the nuclear alignment method do not agree well with the new values. In this connection it is interesting to note that the shape of the β spectrum to the 2^+ level has been determined to be of the type ($\Delta J=3$, no) rather than of the type ($\Delta J=2$,no) which was previously accepted. A new and lower value of the β branching to this level is also consistent with this interpretation.

A forbidden shape of the γ continuum accompanying electron capture has been noted in Ni^{59}.

In the ratio of L to K electron capture in Ge^{71} a large discrepancy exists between the theoretical (0.11) and the experimental value (0.25 ± 0.02). However, the present experimental ratio depends upon the value of the fluorescence yield which is not too well known in this region.

Application of the Coulomb excitation method to the study of low-lying nuclear levels has been continued by several groups. The use of enriched materials has made definite isotopic assignment possible in many cases.

In contrast to previous reports citing evidence for the existence of primordial Tc^{98}, an Oak Ridge paper of 1956 by Boyd and Larson describes a fruitless search for this nucleus in 16 ores. Small amounts of 6.7^h Tc^{99} detected in 2 samples after neutron irradiation were believed produced from traces of 2.2×10^{5y} Tc^{99} which may have been present in the original sample or introduced as an impurity.

Internal conversion of the 0.163-Mev γ of 12^d Xe^{131} was shown by Snell and Pleasanton to give rise to some surprisingly large cascades of Auger electrons. Charges from 1 to 21, with an average of about eight were found on the recoiling Xe^{131} ions. Similar results have been obtained for Rb^{85} which results from the β decay of Kr^{85}.

Last year Scharff-Goldhaber and Weneser pointed out a dramatic change which takes place in the spacing of the levels of even-even nuclei between nuclei containing 88 and those containing 90 neutrons. The ratio of the energy of the second excited state to that of the first excited state jumps from ~2.2 to ~3.3. This year Grodzins and Kendall investigated the decay scheme of Eu^{152} with 89 neutrons and found that its transitions to Gd^{152} with 88 neutrons have smaller ft's than those to Sm^{152} with 90 neutrons. Thus Eu^{152}

is more akin to the 2.2-ratio than the 3.3-ratio family. Scharff-Goldhaber[10] has now shown that a change from a 2.2 to 3.3 ratio also takes place between proton numbers 86 and 88. The region where the change is from 3.3 down to 2.2 is for neutron numbers 112 to 114.[11]

In a search for unknown stable isotopes of very low abundance, relative isotopic abundances for some twenty-five elements were measured. No new stable nucleus was found.

The discovery of a first excited state in La^{137} ten kilovolts above ground has made it reasonable to assign a spin of $7/2^+$ rather than the previous $5/2^+$ to the ground state. This makes the electron capture to the Ba^{137} ground state second forbidden, rather than allowed, and thus consistent with its long lifetime of $\sim 10^5$ years.

Work on the neutron cross section of Xe^{135}, first declassified for the 1955 Geneva meeting, has now been published in detail. Measurements of the total cross section as a function of energy has led to the conclusion that the capture cross section at resonance is 55% of the maximum possible theoretical value if the spin of the capturing state is 2 and 80% if it is 1.

The latest half-life of Rb^{87} obtained by counting methods $(4.3 + 0.3, -0.2) \times 10^{10}$ y, is still not in good agreement with the value obtained by measurement of the ratio Rb^{87}/Sr^{87} in minerals, namely $(5.0 \pm 0.2) \times 10^{10}$ y.

The atomic beam resonance method has been used by Hubbs et al. for measuring the spins of Rb isotopes 81 through 84 all of which are radioactive. The minimum half-life limit set by the equipment is only 10 minutes. Together with previous data there are now measured spin values of Rb isotopes from Rb^{81} through Rb^{87}. The spins of the odd A-isotopes are consistent with the predictions of the shell model and those of even-A isotopes are correctly given by Nordheim's strong rule. This is the first sequence of data in what promises to be a very fruitful attack on the spins of radioactive nuclei.

New instruments of high resolution have been used in the study of the nuclear energy levels of the heavier elements this year. A slow-neutron velocity spectrometer employing a pulsed neutron source from the Nevis synchrocyclotron at Columbia University has been constructed. Data from this instrument show 31 resonances in Ta^{182} between neutron energies of 35 and 215 ev as compared with 16 reported from chopper work by a Russian group.

At the Argonne National Laboratory a bent crystal spectrometer which makes possible the study of low energy neutron capture γ rays was placed in operation. Fourteen γ rays with energies between 0.26 and 0.44 Mev have been reported in Au^{198}. From scintillation spectrometer work only one γ ray in the energy range of 0.1 to 2.5 Mev was reported.

At Uppsala an iron free double-focusing β-ray spectrometer has been constructed which makes possible the comparison of two momenta with an accuracy of one part in 10^5. When X-ray energies are used for calibration, absolute $H\rho$ values with errors of one in 10^4 result. The resulting accuracy is slightly better than that achieved in previous determinations.

The success of the collective model in the very heavy and rare earth regions continues. The energy levels in Lu^{175} (from the decay of Y^{175}) have been accounted for on this model by Chase and Wilets.[12] The nine levels below 0.45 Mev reported last year in W^{183} from the decay of Ta^{183} have been interpreted in terms of two intermixed rotational bands by Kerman.[13] The 5.5^h isomeric transition in Hf^{180} has been found to be due to an E1 0.057-Mev γ. The great slowness of the transition (10^{-5} of the single proton estimate) can be accounted for by K forbiddenness ($\Delta K=9$).

But perhaps the greatest triumphs of the collective model have come from the spins and magnetic moments of ${}_{69}Tm^{169}_{100}$, ${}_{72}Hf^{177}_{105}$, and ${}_{72}Hf^{179}_{107}$. The measured values are $J = 1/2$, $\mu = -0.20$; $J = 7/2$, $\mu = +0.61$; and $J = 9/2$, $\mu = -0.47$ respectively. The shell model predicts $J = 1/2$ for Tm^{169} but requires an $S_{1/2}$ state for which the magnetic moment would be positive. The collective model, however, predicts a negative moment. For the Hf isotopes, $f_{7/2}$, $h_{9/2}$ states are possible single-particle states in the neutron region between $N = 82$ and $N = 126$ (although they should both be filled at $N = 100$). Here again, however, these shell model assignments would require negative and positive magnetic moments respectively, just the opposite from those observed. The Hf spins are given correctly by the collective model[15] but no estimates of the moments have been made.

The collective model also accounts for the new spin values of ${}_{64}Gd^{155}_{91}$, ${}_{64}Gd^{157}_{93}$, ($J = 3/2$ for both) and ${}_{66}Dy^{161}_{95}$ ($J = 5/2$)[15] which on the shell model would have to be attributed to $p_{3/2}$, an orbital not expected until $N = 107$, and to $f_{5/2}$ respectively. The Gd isotopes both have negative moments. The sign of the Dy moment is not known.

A careful measurement[16] of the K, L_1, L_2, and L_3 internal conversion coefficients of the 0.279-Mev γ of Tl^{203} following the β decay of Hg^{203} shows that these quantities are lower than the magnetic dipole K, L_1, and L_2 internal conversion coefficients calculated by Rose by a factor of 0.53 ± 0.08. Calculations by Sliv[17] taking into account finite nuclear size indicate values for K and L_1 mag-

netic dipole conversion coefficients for Z = 83 which differ from Rose's by a factor of 0.65.

A survey of the elements for γ transitions with half-lives >10 μs resulted in the discovery of 7 new transitions with half-lives between 16 and 12,000 μs from bombardment of As, Mo, Pd, W, Tl, and Bi with γ rays from a 24-Mev betatron.[18]

A new level at 0.6189 Mev has been discovered in the much investigated decay scheme of Hf^{181}.

The decay of Pb^{205} by L capture with a half-life of 5×10^7 y has finally been observed.

Summaries of data on slow neutron resonances by Levin and Hughes[19] and by Landon[20] show that Γ_γ is almost constant for the different levels of a given nucleus and that in general it decreases slowly with A except for a marked peak at A = 208. This result can be accounted for by assuming a level density equal to $ce^{\sqrt{aE}}$, the observed discontinuities in the neutron binding energies at the magic numbers, and El transitions. However, the absolute value of the widths as calculated with a modified independent particle model are larger by an order of magnitude than the experimental values.[19]

Intercomparison of boron samples by British and American laboratories resulted in cross sections differing by about 20 barns, the British values being the larger. This year measurement of the cross section of the Harwell standard by an Oxford group using a mean-life method gave a result of 760 ± 3 barns, a value in good agreement with the American value for this sample of 759 ± 5 barns found by transmission measurements. In both cases measurements were not made on the standards directly but on samples with which the standards were later compared by the pile oscillator method. Causes of discrepancies are not yet clear.

This year a paper written jointly by the groups at Argonne National Laboratory and the University of California reported the "instantaneous" absorption of neutrons by uranium in the high neutron flux of thermonuclear explosion of November 1952 resulting in the production of isotopes of uranium up to U^{255} as evidenced by their β decay products. Many of these product nuclei first characterized in the thermonuclear experiment have since been produced by long-time pile irradiations. One of the most interesting of these, Cf^{254} has been shown to decay predominantly by spontaneous fission with a half-life of 55 days. The equality of this decay time with that of supernovae of Type I has led to the suggestion that this nucleus is produced in the stellar outburst by a type of "instantaneous" absorption similar to that occurring in the H bomb explosion and that its half-life governs the decrease in light intensity of the fading star.[21]

1. O. Chamberlain, E. Segrè, C. Wiegand, T. Ypsilantis, Phys. Rev. 100, 947 (1955).
2. B. Cork, G. R. Lambertson, O. Piccioni, W. A. Wenzel, Phys. Rev. 104, 1193 (1956).
3. D. Kurath, Phys. Rev. 101, 216 (1956).
4. A. M. Lane, Proc. Phys. Soc. 68A, 189, 197 (1955).
5. D.R. Inglis, Revs. Mod. Phys. 25, 390 (1953).
6. J. P. Elliott, B. H. Flowers, Proc. Roy. Soc. A229, 536 (1955).
7. M. G. Redlich, Phys. Rev. 99, 1427 (1955).
8. W. Selove, Phys. Rev. 103, 136 (1956).
9. D. Wilkinson, Phil. Mag. 1, 127 (1956).
10. G. Scharff-Goldhaber, Phys. Rev. 102, 837 (1956).
11. K. Way, D. N. Kundu, C. L. McGinnis, R. van Lieshout, Annual Reviews of Nuclear Science 6, 129 (1956).
12. D. M. Chase, L. Wilets, Phys. Rev. 101, 1038 (1956).
13. A. K. Kerman, Kgl. Danske Videnskab Selskab, Mat.-fys. Medd. 30, No. 15 (1956).
14. B. R. Mottelson, S. G. Nilsson, Z. Phys. 141, 217 (1955); K. Gottfried, Phys. Rev. 103, 1017 (1956).
15. B. R. Mottelson, S. G. Nilsson, Phys. Rev. 99, 1615 (1956).
16. C. Nordling, K. Siegbahn, E. Sokolowski, A. H. Wapstra, Nuclear Phys. 1, 326 (1956).
17. L. A. Sliv, Zhur. Eksptl.' i Teoret Fiz. 21, 770 (1951).
18. S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).
19. J. S. Levin, D. J. Hughes, Phys. Rev. 101, 1328 (1956).
20. H. H. Landon, Phys. Rev. 100, 1414 (1955).
21. G. R. Burbidge, F. Hoyle, E. M. Burbidge, R. F. Christy, W. A. Fowler, Phys. Rev. 103, 1145 (1956).

CONVENTIONS

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

Numerals in italics, following measured values, are the errors (as reported by the authors) in the last figure of the values. In cases where confusion seems possible, the conventional ± is used.

Magnetic moments are reported as before without diamagnetic correction. They are based on $\mu(H) = 2.79267$ and the substandards listed by H. Walchli, ORNL-1469.

In writing reactions, the upper right hand superscript denoting A, the mass number of the target nucleus, is given without parentheses when the target was monoisotopic or when enriched (or depleted) material was used to establish the identity of the reacting isotope. It is given in parentheses when natural material was used and when the identity of the reacting isotope was strongly suggested by its predominating abundance, the observed reaction energy, or the activity or yield of the end product. It is given in parentheses with a question mark when the target A was assigned by systematics, elimination, etc. For instance, "B^{10}(d,p)" means that the proton groups from the deuteron bombardment of B^{10} were identified by comparing effects in B^{10} enriched and natural B samples. "B^{11}(d,p)" means that the assignment to B^{11} was made by using B^{11} depleted and natural B samples. "$C^{(12)}$(d,p)" means that natural C was used to study the reaction, but, because of the 99% abundance of C^{12}, the reaction observed was assumed to take place in that isotope. In the reaction "$Sn^{(116)}$(n,p)$13^{s}In$," the Sn isotope was identified by the In product. "$Te^{(125?)}$(d,p)$Te^{(126?)}$" indicates that from the trend of Q values in the region, the experimenters believed that their measured Q most likely belonged to the indicated reaction.

When a method of production of a radioactive nucleus is given, the lowest bombarding energy used by the experimenter is indicated; e.g., Ag(20-Mev p,n).

The large black dots on the decay schemes are used to indicate experimentally established coincidences. α, β, or γ rays entering a level and dotted at their arrowheads have been shown to be in coincidence with gamma rays leaving the same level and dotted at their origins. In case of a simple cascade, the dots of the incoming and outgoing rays are superimposed. Dashes are used for doubtful radiations or levels.

For the light nuclei, energy levels in the compound nucleus are usually tabulated rather than the resonant energy of the bombarding particle. The binding energy of the bombarding particle in the compound nucleus is taken from the table of F. Ajzenberg, T. Lauritsen, Revs. Modern Phys. 27, 77(1955) for Z < 11 and from P. M. Endt, J. C. Kluyver, Revs. Modern Phys. 26, 95(1954) for Z from 11 to 20.

ABBREVIATIONS

a	absorption
a $\beta\gamma$	absorption of β's in coincidence with γ's
a ce	absorption of conversion electrons
a coin	absorption of photoelectrons between counters in coincidence
act	neutron detection by activation (Mn, Rh, Ag, ...)
α	total γ-ray conversion coefficient, N_e/N_γ
$\alpha_K, \alpha_L, \ldots$	γ-ray conversion coefficient for electrons ejected from the K, L, ... shell
$\alpha_o, \alpha_1, \ldots$	α to g.s., first excited state, ... of residual nucleus
B	band spectra method
B(E2)	reduced E2 excitation probability in barns^2 (upward transition)
Be(γ,n)	measurement by detection of photoneutrons from Be
BF_3	boron trifluoride neutron counter
B_n, B_p	neutron, proton binding energy, i.e., energy necessary to remove particle from nucleus
$\beta\gamma$ ($t_\perp$)	polarization-direction correlation of β's and γ's in coincidence
$\beta\gamma(\theta)$	angular correlation of β's and γ's in coincidence
calc	calculated from experimental work reported elsewhere
cc	cloud chamber
CcW	Cockcroft Walton accelerator
ce	conversion electrons
chem	chemical separation of product following reaction
Cp	Compton
crit a	critical absorption
cryst	crystal spectrometer
cyc	cyclotron
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript
D	double resonance method
d,p(θ)	angular distribution of protons with respect to deuteron beam
D(γ,n),D(γ,p)	measurement by detection of photoneutrons or photoprotons from deuterium
E	average energy
E_o	resonance energy
$E_\beta, E_\gamma, \ldots$	energy of β ray, energy of γ ray,
E_{dis}	disintegration energy
EA	electrostatic analyzer
E1,E2, ...	electric dipole, electric quadrupole, ...
E_ϵ	energy of the electron capture transition (end point of γ continuum + K binding energy)
e_A	Auger electron
e_{AK}, e_{AL}	KXY, LXY Auger electron
el	elastic scattering
ϵ	electron capture
ϵB(E2)	partial B(E2) for radiation studied (photon, ce_K, or ce_L)
ϵ_K, ϵ_L	electron capture from K, L shell
$\eta(\theta)$	$[W(\theta) - W(\pi/2)]/W(\pi/2)$, a measure of asymmetry in angular distributions, where $W(\theta)$ is the count at angle θ
f	fission
F-K	Fermi-Kurie plot
ft	comparative half-life in the Fermi theory of β decay calculated for an allowed transition. Superscript 1, 2, or 3 on *f* indicates that comparative half-life is calculated for a unique 1st, 2nd, or 3rd forbidden transition.
g	(1) gyromagnetic ratio (2) statistical weight factor, $\frac{1}{2}[1 \pm 1/(2J+1)]$, in g Γ_n
Γ	resonance half-width (the whole width at half-maximum)
Γ_γ, Γ_n	partial resonance half-width for γ, neutron emission
$\gamma^\pm$	annihilation radiation
γ continuum	continuous γ spectrum associated with electron capture
$\gamma(Hg^{198})$	γ is emitted from nucleus in parentheses rather than from radioactive parent
$\gamma(\theta, T)$	γ intensity as function of angle and temperature
$\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, nγ	$\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, or nγ concidences. (0.123 γ)(0.246 γ, 0.325 γ) means 0.123 γ in coincidence with 0.246 γ and 0.325 γ
$\gamma\gamma(\theta)$	angular correlation of γ's in coincidence
$\gamma\gamma(t_\perp)$	polarization-direction correlation of γ's in coincidence
GM	Geiger-Müller counter
g.s.	ground state
h	hours

I	nuclear induction method
IB	internal bremsstrahlung
ic	ionization chamber
IT	isomeric transition
J	spin in units $h/2\pi$
K/L, K/LM	α_K/α_L, $\alpha_K/(\alpha_L + \alpha_M)$
L_1L_2/L_3	$(\alpha_{L_1} + \alpha_{L_2})/\alpha_{L_3}$
l	orbital angular momentum
Lin	linear accelerator
m	(1) medium intensity, (2) minutes, when used as a superscript
M	molecular or atomic beam resonance method
M1,M2, ...	magnetic dipole, magnetic quadrupole, ...
mb	millibarns
Mev	million electron volts (10^6 ev)
mev	millielectron volts (10^{-3} ev)
Mic	microwave method
mir	measurement by total reflection of neutron beam from mirror surface
mod cyc	modulated cyclotron
ms	(1) milliseconds, 10^{-3}s (2) mass spectrometer
mμs	millimicroseconds, 10^{-9}s
μ	nuclear magnetic moment (nuclear magnetons)
μ_3	nuclear magnetic octopole moment (nuclear magneton barns)
μs	microseconds, 10^{-6}s
μμs	micromicroseconds, 10^{-12}s
n res	known resonance of a "standard" element used to identify an unknown neutron energy
ν	neutrino
osc	pile oscillator method
θ^2	reduced level width in units of $3h^2/8\pi^2MR$
p	(1) proton, (2) predecessor of
para	paramagnetic resonance method
parentheses	parentheses are put around values which are given for identification purposes
pc	proportional counter
pe	photoelectrons
ppl	photoplates or emulsions
pr	electron-positron pair
p res	proton resonance. Magnetic field standardized by means of proton resonance frequency
primes	primes indicate inelastically scattered particles
q	electric quadrupole moment in units of barns
quad res	quadrupole resonance method
q_4	nuclear electric 16-pole moment in units of 10^{-48} cm^4
Q	reaction energy in Mev
R	nuclear radius in fermis (10^{-13} cms)
s	(1) spectrometer method, (2) seconds, when used as superscript
s coh	coherent scattering
S	atomic spectra measurement
scin	1-crystal scintillation counter
scin Cp	2-crystal scintillation counter
scin pr	3-crystal scintillation counter
sd	double focusing spectrometer
sl	lens spectrometer
sl ce	conversion electrons measured in lens spectrometer
sr	steradian
st	strong
sπ	180° spectrometer
sπ pr	180° pair spectrometer
σ	cross section in barns
σ_0	cross section at resonance energy, E_0
σ_a	absorption cross section
σ_t	total cross section
Σpc	proportional counter used to sum energy of transitions in cascade
Σscin	scintillation counter used to sum energy of transitions in cascade
t	(1) triton, H^3, (2) total cross section when used under σ in cross section list
T	(1) isotopic spin, (2) temperature
τ	half life in units indicated
τ_1,τ_2	half life of upper, lower state
$\tau_{\beta\beta},\tau_{\epsilon\epsilon}$	half life for double β, double ϵ decay
th	thermal
thresh	threshold
trans	transmission
VdG	Van de Graaff accelerator
w,vw	weak, very weak
ω_K,ω_L	K,L fluorescence yield
x	x radiation
y	years
Y_γ,Y_p, ...	yield of γ rays, yield of protons, ...
%	number per 100 disintegrations. For γ's, total number of photons plus ce's is meant
†	number relative to other numbers marked †. For γ's, number of photons only is meant
+,−	even, odd parity when used in connection with level properties

Standard journal abbreviations are used.

LIST OF JOURNALS SURVEYED FOR NSA VOL. 10

Numbers following a colon are issue numbers, other numbers (except years) are volume numbers. All numbers are inclusive.

Acad. Brasileira Ciencias 22-27(1950-1955).
Acta Physica Hung. 5: 2-4(1955); 6: 1(1956).
Acta Phys. Austriaca 10: 1-2(1956).
Ann. Phys. 10: Sept.-Dec.(1955); 1: Jan.-June (1956).
Ann. Physik 16,17(1955); 18: 1-4(1956).
Arkiv Fysik 9: 6(1955); 10: 1-6(1956).
Australian J. Phys. 8: 3-4(1955); 9: 1-2(1956).
Bull. Am. Phys. Soc. 1: 1-6(1956).
Bull. Inst. Nuclear Sci. Boris Kidrich 6(1956).
Bull. Research Council Israel 5A: 1-3(1955-56).
Can. J. Chem. 33: 12(1955); 34: 1-9(1956).
Can. J. Phys. 33: 11-12(1955); 34: 1-9(1956).
Compt. rend. 241: 14-26(1955); 242: 1-26; 243: 1-17(1956).
Current Sci. 24: 10-12(1955); 25: 1-9(1956).
Czechoslov. J. Phys. 6: 1-3(1956).
Doklady Acad. Nauk SSSR 98: 4-6; 99(1954); 100, 101, 102, 103, 104, 105(1955).
Helv. Phys. Acta 28: 4-7(1955); 29: 1-2(1956).
Indian J. Phys. 29: 6-12(1955); 30: 1-4(1956).
Izvest. Acad. Nauk Ser. Fiz. SSSR 19: 1-2(1955).
J. Am. Chem. Soc. 77: 22-24(1955); 78: 1-20 (1956).
J. Chem. Phys. 23: 11-12(1955); 24: 1-6; 25: 1-2(1956).
J. Inorg. Nuclear Chem. 1: 1-6(1955); 2: 1-6 (1956).
J. Nuclear Energy 2: 2-4(1955-56).
J. Phys. Chem. 59: 11-12(1955); 60: 1-9(1956).
J. phys. radium 16: 11-12(1955); 17: 1-9(1956).
J. Phys. Soc. Japan 10: 11-12(1955); 11: 1-8 (1956).
J. Research Nat. Bur. Standards 55: 5-6(1955); 56; 57: 1-4(1956).
Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 29: 15-19(1955); 30: 1-16(1956).
Nature 176: 4488-4496(1955); 177; 178: 4523-4538(1956).
Naturwiss. 42: 21-24(1955); 43: 1-20(1956).
Nuclear Phys. 1: 1-8(1956).
Nuclear Sci. Eng. 1: 1-5(1956).
Nuovo Cim. 2: 5-6(1955); 3: 1-6(1956).
Phil. Mag. 46: 381-383(1955); 1: 1-8(1956).
Physica 21: 10-12(1955); 22: 1-9(1956).
Phys. Rev. 100(1955); 101; 102; 103: 1-4(1956).
Proc. Indian Acad. Sci. 33-43(1951-1956).
Proc. Phys. Soc. 68A: 430-432(1955); 69A: 433-438(1956).
Proc. Roy. Soc. 233A(1955); 234A-236A(1956).
Rev. Mexicana Fis. 4: 4(1955); 5: 1-2(1956).
Zhur. Eksptl' i Teoret. Fiz. 28(1955).
Z. Naturf. 10a: 9-12(1955); 11a: 1-9(1956).
Z. Phys. 141-143(1955); 144; 145: 1-4(1956).

For information on reports and occasional papers in journals other than the above, Nuclear Science Abstracts, Chemical Abstracts, and Physics Abstracts are surveyed.

1. RADIOACTIVITY, LEVELS, ABUNDANCES, MOMENTS

?

α tracks of ranges 3 to 4, 10, and 14μ (energies 1 to 1.5, 3, 4 Mev) seen in ppl after immersion in solutions of Fe salts. 3 to 4μ tracks sometimes found without others which seem to have $\tau \lesssim$ several days.

R.Coppens, Compt. rend. 243, 582 (1956).

155 tracks (range 100 to 300μ, not electrons) observed in ppl from Pu^{239} source. Similar tracks seen with active deposit of Po, Ac, and Th.
About one "long" track per 10^7 normal α's

M.Ader, J. phys. radium 17, 541 (1956); Compt. rend. 241, 1748 (1955).

ν

Neutrino detected
by establishing, near nuclear reactor, the existence of $p + \nu \rightarrow n + \beta^+$ through observation of (1) coincident pulses due to $\gamma^{\pm}$, (2) coincident pulses due to γ's following n capture, (2) being delayed with respect to (1).
$\sigma[H^{(1)}(\nu,\beta^+)n] = 10^{-19}$ b for fission ν

$\mu(\nu) \quad < 10^{-9}$ Bohr magnetons
from counting rate of single pulses assumed due to e^-,ν interaction

C.L.Cowan, Jr., F.Reines, F.B.Harrison, H.W. Kruse, A.D.McGuire, Science 124, 103 (1956); Nature 178, 446 (1956); Phys. Rev. 96, 1294 (1954).

$\sigma[Cl^{37}(\nu,e^-)A^{37}] < 0.9\times10^{-21}$b for fission ν

R.Davis, Jr., Bull. Am. Phys. Soc. 1, No. 4, 219 UA5 (1956).

$n^1_{0\ 1}$

Neutron electron interaction
$V = -4120 \pm 300$ ev (range $= e^2/mc^2$) from transmission in liquid Bi, $E_n = 0.1$ to 10 ev

E.Melkonian, B.M.Rustad, W.W.Havens, Jr., Bull. Am. Phys. Soc. 1, No. 1, 62, UA8 (1956); verbal report.

$\mu \qquad -1.913138 \qquad M$
$\nu(n)/\nu(p) = 0.685057\ 16$

N.R.Corngold, V.W.Cohen, N.F.Ramsey, Bull. Am. Phys. Soc. 1, No. 1, 11, B7 (1956).

$n^1_{0\ 1}$
12^m

$\beta^- \qquad$ s1 for β's from $p\beta(145° < \theta < 175°)$
$p\beta^-(E_\beta)$ consistent with $g_T^2/g_S^2 = 1.49\ ^{+1.44}_{-0.56}$

J.M.Robson, Phys. Rev. 100, 932 (1955).

$H^1_{1\ 0}$

$\mu \qquad 2.79268\ 10$
Used Jeffries type decelerating cyclotron
Value given is without diamagnetic correction

K.R.Trigger, Bull. Am. Phys. Soc. 1, No. 4, 220 UA8 (1956); priv. comm.

$H^2_{1\ 1}$

Capture $\gamma \qquad H^{(1)}(n,\gamma) \qquad E_n$ = th
100† (2.23) scin
No other γ (<3†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

$H^3_{1\ 2}$
12^y

$\tau \qquad 12.262^y\ 4 \qquad He^3$ growth

W.M.Jones, Phys. Rev. 100, 124 (1955).

$H^4_{1\ 3}$

$C^{(12)}$(300, 430-Mev p)
No evidence for β emitter, $E_\beta > 12$, $\tau = 1$ to 10^{ms}
$\sigma(\tau = 2$ to $4^{ms}) < 10^{-6}$ a, delay
$\sigma(\tau = 4$ to $10^{ms}) < 10^{-5}$

A.A.Reut, S.M.Korenchenko, V.V.Yur'ev, B.M. Pontecorvo, Doklady Akad. Nauk SSSR 102, 723 (1955); AERE Lib/Trans. 600.

$He^4_{2\ 2}$

Level $\qquad H^3(p,n) \qquad E_p = 1.4$ to 6.8
100* 22 $J = 2^-$ p,n(θ);BF_3
σ has broad max at $E_p = 3$. Large $\int d\sigma$ at max (0.58) implies $J = 2$. Increase with E_p of asymmetry in p,n(θ) suggests 1^- level at >25
*Peak $\sigma(0°)$ in mb/sterad

$H^3(p,\gamma) \qquad E_p = 1.7$ to 6.8
No resonance observed scin >14-Mev γ

N.A.Vlasov, S.P.Kalinin, A.A.Ogloblin, V.A. Sidorov, V.I.Chuev, Soviet Phys. JETP 1, 500 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 639 (1955).

Level? $\qquad He^3(n) \qquad E_n = 0.2$ to 22
σ_t shows broad maximum at $E_n = 1.9$ 2

L.Cranberg, R.L.Mills, T.R.Roberts, R.B. Beyster, R.B.Day, R.L.Henkel, R.A.Nobles, R.K.Smith, S.G.Sydoriak, R.G.Taylor, M.Walt, LA-1853 (1954).

$He^4_{2\ 2}$

$He^{(4)}(p,p')$ $E_p = 28$ cc
$He^{(4)}(p,2p)$

No level found $\sigma(p,p') < 2$ mb

A.P. Wickersham, UCRL-2662 (1954).

$He^{(4)}(p,p')$ $E_p = 40$ scin

No level found between 23 and 28 Mev
$\sigma(65°) \leq 0.25$ mb/sterad if $\Gamma < 0.5$

R.M. Eisberg, Phys. Rev. 102, 1104 (1956); Bull. Am. Phys. Soc. 1, No. 1, 19 DA1 (1956).

$H^2(d,n)$ $E_d = 0.039$ to 0.087
$H^2(d,p)$ He^3, H^3 detected, pc

E_d	0.0387	0.0522	0.0647	0.0869
A_n		0.654 *23*		0.931 *26*
A_p		0.360 *23*		0.503 *17*
σ_n in mb		4.64 *27*		11.85 *83*
σ_p in mb		4.59 *34*		11.41 *65*
σ_n/σ_p	0.996 *20*	1.008 *17*	1.030 *18*	1.038 *13*
$\sigma_n(90°)/\sigma_p(90°)$		0.926 *14*		0.925 *11*

A_n, A_p are the neutron and proton asymmetry coefficients in $\sigma(\theta) = \sigma(90°)[1 + A\cos^2\theta]$

D.L. Booth, G. Preston, P.F.D. Shaw, Proc. Phys. Soc. 69A, 265 (1956).

$H^2(d,n)$ $E_d = 0.25$ to 0.82

d,n(θ,E) studied. Less isotropy found than in previous work. Stripping-theory fit possible if R assumed to decrease as E_d increases.
2 crystal delay spectrometer

P.R. Chagnon, G.E. Owen, Phys. Rev. 101, 1798 (1956).

$H^2(d,n)$ $E_d = 1.15$ to 4.60

Table of $\sigma(0°)$ given ppl

$H^3(p,n)$ $E_p = 8.8$ to 11.4

Table of $\sigma(0°)$ given ppl
$\sigma(0°)$ increases with E_p from 16 to 31 mb/sterad

L. Stewart, G.M. Frye, Jr., L. Rosen, Bull. Am. Phys. Soc. 1, No. 2, 93, M2 (1956).

$He^5_{2\ 3}$

Level $Li^{(7)}(d,\alpha)$ $E_d = 3.7$
g.s. $Q = 13.719$ *20* s

L.N. Khromchenko, V.A. Blinov, Soviet Phys. JETP 1, 596 (1955); Zhur. Eksptl'. i Teoret. Fiz. 28, 741 (1955).

$H^3(d,n)$ $E_d = 0.2$ to 6.25

Tables of $\sigma(\theta,E)$ given pc, scin

S.J. Bame, Jr., J.E. Perry, Jr., Bull. Am. Phys. Soc. 1, No. 2, 93, M3 (1956).

$H^3(d,n)$ $E_d = 1$ to 5; pc + scin

No sharp resonance but σ rising at $E_d = 5$
Forward peak in d,n(θ) sharper with higher E_d

C.H. Johnson, A. Galonsky, Phys. Rev. 100, 1252A (1955).

$He^5_{2\ 3}$

Polarization $H^2(d,n)$; $He^{(4)}(n,n)$
Azimuthal asymmetry of n's scattered from He studied. Results consistent with polarization calc. with Seagrave[1] not Huber[2] phases.

I.I. Levintov, A.V. Miller, V.N. Shamshev, Doklady Akad. Nauk SSSR 103, 803 (1955).
[1]Phys. Rev. 92, 1222 (1953).
[2]Helv. Phys. Acta 25, 437 (1952).

$He^6_{2\ 4}$

τ 0.852^S *16* Be^9(pulsed n,α)

0.83^S

N. Veeraraghavan, Proc. Indian Acad. of Sciences 43A, 319 (1956).

τ 0.817^S Be^9(pulsed n,α)

E.C. Campbell, P.H. Stelson, ORNL-2076 p. 32 (1956).

$He^6_{2\ 4}$

Levels $Li^{(7)}(t,\alpha)$ $E_t = 0.84$

1.3*	g.s.	Q = 9.79 *14*	ppl 90°;
2.1*	1.7	γ decay	$E_t = 3.8$
	6.0 ? *9*	α decay ?	ppl loaded
	9.3 *7*	α decay	with Li

*$\sigma(90°)$ in mb/sterad for $E_t = 0.84$

D. Magnac-Vallette, P. Cüer, J. phys. radium 17, 553 (1956); Compt. rend. 242, 760 (1956).

$H^3(t,t)$ $E_t = 1.6$ to 2.0

$\sigma(\theta,E)$ measured. No evidence of He^6 excited state between 13.05 and 13.25 pc in coinc

D.M. Holm, H.V. Argo, Phys. Rev. 101, 1772 (1956).

Li_3

Relative isotopic abundances ms

Li^6	8.12%	$Li^7/Li^6 = 11.32$
Li^7	91.88%	No error given

No Li^5 ($< 7 \times 10^{-5}$%) No Li^8 ($< 1 \times 10^{-4}$%)

F.A. White, T.L. Collins, F.M. Rourke, Phys. Rev. 101, 1786 (1956).

$Li^5_{3\ 2}$

Polarization $He^{(4)}(p,p)$; (p,p) ppl
$E_{p1} = 5.32$, $\theta_1 = 45°$ for 1st scattering, S_1
$E_{p2} = 2.7$, $\theta_2 = \pm 90°$ for 2nd scattering, S_2
P_1, polarization after S_1, = 0.40 ± 0.05 agreeing with $P_1 = 0.39 \pm 0.04$ calc. from phase shifts.
$p_{1/2}, p_{3/2}$ splitting of several Mev implied.

A.C. Juveland, W. Jentschke, Z. Phys. 144, 521 (1956).

Polarization $He^{(4)}(p,p)$; (p,p) $E_p = 3.0$; ppl
$\theta_1 = 90°$ c.m.; $\theta_2 = \pm 73°$, $\pm 100°$, $\pm 125°$ c.m.
P_1P_2 from forward-backward ratio agrees with value calculated from phase shifts

M.J. Scott, R.E. Segel, Phys. Rev. 100, 1244 (1955).

$Li^5_{3\ 2}$ Capture γ's $H^2(He^3,\gamma)$ $E_{He^3} \leq 1.5$; scin
E_γ(max) ~16.5, spread in E_γ ~several Mev

W. E. Kunz, J. W. Butler, H. D. Holmgren, Phys. Rev. 100, 1252A (1955).

$He^{(4)}(p,p)$ $E_p = 7.5$, 31 angles
Phase shifts agree with values for lower E_p

T. M. Putnam, J. E. Brolley, Jr., L. Rosen, Bull. Am. Phys. Soc. 1, No. 1, 9, AB2 (1956).

$He^{(4)}(p,p)$ $E_p = 17.45$
$p,p(\theta)$ found for $6.8° < \theta < 168°$ c.m. scin
Phase shifts given

K. W. Brockman, Jr., Phys. Rev. 102, 391 (1956).

$Li^6_{3\ 3}$ Levels $Li^{(7)}(p,d)$ E_p ~18

17†	g.s.	$l_n = 1$	p,d(θ)
8.5†	(2.19)	$l_n = 1$	

†Peak σ in mb/sterad c.m.

J. B. Reynolds, K. G. Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

$Li^7_{3\ 4}$ Level $Be^9(d,\alpha)$ $E_d = 0.45$
$Li^6(d,p)$ $E_d = 0.50$
(0.478) $\tau = 5.3 \times 10^{-14}$ s 6
From Doppler shift. Stopping power measured.

D. S. P. Bunbury, S. Devons, G. Manning, J. H. Towle, Proc. Phys. Soc. 69A, 165 (1956).

Levels $Be^9(d,\alpha)$ $E_d = 0.50, 0.70$
4.62 s; 70°
No evidence of 5.5 level

R. W. Gelinas, S. S. Hanna, Phys. Rev. 100, 1253A (1955).

Levels $Li^{(6)}(d,p)$ $E_d = 3.7$ to 4.7
4.454 ~20 s
6.530 ~20
Based on g.s. Q = 5.020

L. M. Khromchenko, V. A. Blinov, Soviet Phys. JETP 1, 596 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 741 (1955).

Levels $Be^9(d,\alpha)$ $E_d = 3.5$
4.6 8000 tracks of mag-
6.6 netically separated
No evidence of 5.5 level t's studied in ppl

J. J. Jung, P. Cüer, J. phys. radium 17, 555 (1956).

Level $Li^6(n,n)$ $E_n = 0.21$ to 0.40
(7.46) $J = 5/2^-$ n,n(θ)

H. B. Willard, J. K. Bair, J. D. Kington, H. O. Cohn, Phys. Rev. 101, 765 (1956).

$Li^7_{3\ 4}$ $He^{(4)}(t,t)$ $E_t = 1.2$ to 2.2
Table of $\sigma(\theta,E_t)$ given

A. Hemmendinger, Bull. Am. Phys. Soc. 1, No. 2, 96, N7 (1956).

$Li^6(n,\alpha)$ $E_n = 0.88$ to 14.1
$\sigma(E_n) \propto 1/E_n$ beyond hump at E_n ~2. Hump attributed to competing reactions rather than level.

F. L. Ribe, Phys. Rev. 741 (1956).

$Li^8_{3\ 5}$ 0.84^s $B^{(11)}$(12 to 20-Mev n,α)$Li^8 \xrightarrow{\beta} Be^8 \rightarrow 2\alpha$; ppl
No evidence found for β decay to Be^8 levels above 2.9

A. H. Armstrong, G. M. Frye, Jr., Phys. Rev. 103, 335 (1956).

$Li^8_{3\ 5}$ Levels $Li^{(7)}(d,p)$ $E_d = 3.7$ to 4.7
g.s. Q = -0.183 20 s
0.977 20

L. M. Khromchenko, V. A. Blinov, Soviet Phys. JETP 1, 596 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 741 (1955).

Level $Li^{(7)}(n,n)$ $E_n = 0.229$ to 0.275
(2.28) $J = 3^+$ n,n(θ)
Background s-wave channel spin 2 predominant

R. G. Thomas, M. Walt, R. B. Walton, R. C. Allen, Phys. Rev. 101, 759 (1956).

Level $Li^7(n,n)$ $E_n = 0.20$ to 0.60
(2.28) $J = 3^+$ n,n(θ)
Background s-wave channel spin statistical

H. B. Willard, J. K. Bair, J. D. Kington, H. O. Cohn, Phys. Rev. 101, 765 (1956).

Polarization $Li^{(7)}(p,n)$; $Li^{(7)}(n,n)$
$E_p = 2.2, \theta_1 = 70°$; $E_n = 0.28, \theta_2 = \pm 49°, \pm 82°$
P_1P_2 (due to Li^8 2.28 level) ~0.24

H. B. Willard, J. K. Bair, H. O. Cohn, J. D. Kington, Bull. Am. Phys. Soc. 1, No. 1, 54 R1 (1956).

$Be^7_{4\ 3}$ 54^d τ 53.0^d 4 $C^{(12)}$(160-Mev p) chem
$[\lambda(Be) - \lambda(BeF_2)]/\lambda = 0.0012$ 1 differential ic

R. Bouchez, J. Tobailem, J. Robert, R. Muxart, R. Mellet, P. Daudel, R. Daudel, J. phys. radium 17, 363 (1956).

$Be^7_{4\ 3}$ Levels $Li^{(7)}(p,n)$ $E_p = 2.6$ to 2.9
100+ g.s. $He^3(n,p)$ detector
~4+ to 10+ (0.43) at several angles
p,n(θ) ~ isotropic for both n groups
σ(0.43 level)/σ(g.s.) increases with E_p

R. Batchelor, G. C. Morrison, Proc. Phys. Soc. 68A, 1081, 452 (1955).

$Be^{7}_{4\ 3}$

Level $Li^{(7)}(p,n)$ $E_p = 1.8$ to 4.5; VdG, thresh n, ~0°
0.434 *4*
$\sigma(0.434\ \text{level})/\sigma(\text{g.s.}) = 0.0018$ *6* for $E_p = 2.40$

J.B. Marion, T.W. Bonner, C.F. Cook, Phys. Rev. 100, 91 (1955).

Level $B^{10}(p,\alpha)$ $E_p = 1.45$
(0.43) $\tau = 1.9 \times 10^{-13}$ s *7*
From Doppler shift. Stopping power estimated.

D.S.P. Bunbury, S. Devons, G. Manning, J.H. Towle, Proc. Phys. Soc. 69A, 165 (1956).

Capture γ's $Li^{6}(p,\gamma)$ $E_p = 0.4$ to 1
38† ~5.8 Q = 5.66 *3* scin
62† ~6.2
†Intensity ratio not f(E or θ). $W(\theta) = 1 + \cos^2\theta$

J.B. Warren, T.K. Alexander, G.B. Chedwick, Phys. Rev. 101, 242 (1956).

$Be^{8}_{4\ 4}$

Level $Be^{9}(p,d)$ $E_p = 16.5$
11† g.s. $l_n = 1$ (2?) p, d(θ)
†$\sigma(23°)$ in mb/sterad c.m.
Stripping theory fit requires R = 3 while at $E_p = 5$, R = 6 is needed. Cf. He^{4}, Chagnon.

J.B. Reynolds, K.G. Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

Level $Be^{9}(p,d)$ $E_p = 31.3$
g.s. $l_n = 1$? p, d(θ)
Poor stripping-theory fit (R = 4)

J. Benveniste, R.G. Pinke, E.A. Martinelli, Phys. Rev. 101, 655 (1956).

Levels $Be^{9}(d,t)$ $E_d = 3.5$, 30°
g.s. 8000 tracks of magnetically separated
2.2? t's studied in ppl
2.9

J.J. Jung, P. Cüer, J. phys. radium 17, 555 (1956).

Levels $B^{(10)}(d,\alpha)$ $E_d = 5$
g.s. S 50°, 90°
2.9
No other levels found between 0 and 9 Mev

C. Bockelman, A. Lévêque, J. phys. radium 17, 557 (1956).

$Be^{9}(d,t)$ $E_d = 0.47$ to 1.15
No evidence of level 4.0 to 4.3 s; 23° to 90°

R.W. Gelinas, S.S. Hanna, Phys. Rev. 100, 1253A (1955).

$Be^{8}_{4\ 4}$

Levels $Li^{7}(p,\gamma)Be^{8} \rightarrow 2\alpha$ $E_p = 0.44$
(2.9) s, ppl 70°, 90°
~10 very broad
No α groups corresponding to Be^{8} levels at 4.1, 5.3, 7.5 (<1.0, 0.5, 0.5% of total α's)

E.C. LaVier, S.S. Hanna, R.W. Gelinas, Phys. Rev. 103, 143 (1956); 100, 1252A (1955).

Levels $Li^{6}(He^{3},p)$ $E_{He^3} = 1.25$
g.s. 45°, 90°, 135°
100† 2.9 absorbers + scin
5.6† 12.3 $\Gamma \sim 2$
No evidence for levels at 4.05, 4.9, 5.3, 7.5 (<1† if sharp, <3† if broad)

C.D. Moak, W.R. Wisseman, Phys. Rev. 101, 1326 (1956).

Levels $C^{(12)}(\gamma,\alpha)$ $E_\gamma = 17.6$; ppl
3.2 455 stars
4.0
7.5 broad
9.0

H. Glättli, E. Loepfe, P. Stoll, Helv. Phys. Acta 28, 366A (1955).

Levels $C^{(12)}(\gamma,\alpha)$ 2500 stars; ppl

Level		Γ	J	$E_\gamma \leq 40$
g.s.		0.03	0	
2.95	*10*	0.70 *15*	2	
4.0	*1* ?	<0.3	2,4	
6	?	<1.0	0,2,4	
10	?	<1.0	0,2,4	
15	?	<1.0	0,2,4	
16.4	*2* ?	<0.4	0,2	
16.8	*2*	<0.3	2	
17.6	*2*	<0.3	2(0?)	

? Not only possible interpretation of data $\gamma,\alpha(\theta)$ for g.s., 2.9, 16.8, 17.6 levels. See C^{12}.

F.K. Goward, J.J. Wilkins, Proc. Roy. Soc. 228, 376 (1955).

Levels $C^{(12)}(\gamma,\alpha)$ $E_\gamma \lesssim 27, \lesssim 33$
Distribution of Be^{8} excitation energies calculated from 485 stars shows maxima at ~ 2.5, ~ 10.5, ~ 13.5, ~ 16.5 ($\Sigma E_\alpha > 12.5$)
~ 2.5, ~ 9 ($\Sigma E_\alpha < 12.5$)

P.I. Havlíček, B. Dobovišek, Phys. Rev. 100, 1355 (1955).

Levels $Li^{7}(d,n)$ $E_d = 0.92$ ppl
Energy distribution of 1200 tracks shows maxima corresponding to Be^{8} levels at g.s., 3.0, 4.1, 4.8, 5.8, 7.5, 9.6
n group to g.s. has experimental width of 0.43

J.R. Bird, R.H. Spear, Australian J. Phys. 8, 567 (1955).

Be^8_4 4

Level $B^{(11)}(p,\alpha_i)Be^8 \rightarrow 2\alpha_j$ $E_p = 0.163$
(2.9) $J = 2$ $\alpha_i\alpha_j(\theta)$

E.H.Geer, E.B.Nelson, E.A.Wolicki, Phys. Rev. 100, 215; 98, 241A (1955).

Level $Li^7(p,\gamma)Be^8 \rightarrow 2\alpha$ $E_p = 0.45$
(2.9) $J = 2^+$ scin $\gamma\alpha(\theta)$
$[\gamma\alpha(120°)]/[\gamma\alpha(180°)] \sim 1.2$

A.J.F.Boyle, Nuclear Phys. 1, 581 (1956).

Levels $Be^9(p,d)$ $E_p = 95$
g.s. and 2.9 p,d(θ)
~17
p,d(θ) for $E_p = 5$ to 95 accounted for by transparent nucleus, Born approximation, and pick-up theory

W.Selove, Phys. Rev. 101, 231 (1956); S. Glashow, W.Selove, Phys. Rev. 102, 200 (1956).

Levels $Li^{(7)}(p,\gamma)$ $E_p = 0.40, 0.47, 0.54$
No levels between 7 and 15 Mev excited (<3% of g.s.) pc for γ's, 90°

A.C.Riviere, P.B.Treacy, Australian J. Phys. 8, 408 (1955).

Level $Li^{(7)}(p,\gamma)$ p res. calibration
17.628 $E_o = 0.4412$ *6* S77

F.Bumiller, H.H.Staub, H.E.Weaver, Helv. Phys. Acta, 29, 83 (1956); 28, 355A (1955).

γ $Li^{(7)}(p,\gamma)$ $E_p = 0.20$ to 0.44
$17.6\gamma/14.8\gamma$ increases with E_p by factor of 3.4 in above E_p range scin

J.G.Campbell, Australian J. Phys. 9, 156 (1956).

Levels $Li^7(p,p)$ $E_p = 1.3$ to 3.0
At 6 angles from 70° to 167°, σ shows max at 2.000, dip at 2.230, anomaly near 1.882

P.R.Malmberg, Phys. Rev. 101, 114 (1956); 98, 1167A (1955).

Resonances $Li^{(7)}(p,n)$ long counter, 0°
Peaks found at $E_p = 2.30$, 3.2?

J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955).

Be^9_4 5

	ground state	
J	3/2	I
$\lvert\mu\rvert$	1.1774 *2*	

L.C.Brown, D.Williams, J.Chem. Phys. 24, 751 (1956).

Be^9_4 5

Level $Be^9(p,d)$ $E_p = 31.3$
g.s. $l_n = 1$? p,d(θ)
See Be^8, Reynolds, Standing; Benveniste et al.

Levels $Be^9(p,p')$ $E_p = 4.6$ to 5.3
23† g.s. s
1† 1.675 *2* ?*
~4† 2.432 *4* $\Gamma \leq 0.001$ implies $J \geq 5/2$
†$\sigma(170°)$ in mb/sterad
*Attributable to level or 3-body break-up

C.R.Gossett, G.C.Phillips, J.P.Schiffer, P.M. Windham, Phys. Rev. 100, 203 (1955).

Levels $Be^9(\alpha,\alpha')$ $E_\alpha = 21.6$
$Be^9(d,d')$ $E_d = 10.8$
1.74 *10* ?* s; several
(2.428) angles
3.01 *10*
*Attributable to level or 3-body break-up

D.W.Miller, V.K.Rasmussen, W.B.Sampson, U.C. Gupta, Phys. Rev. 100, 851, 1253A (1955).

Levels $Be^9(\alpha,\alpha')$ $E_\alpha = 44$; a pc
g.s. 13°, 70°, 114°
< 1† 1.8
10† 2.4 *1* 13°, 70°, 114°
5† 3.1 ? 70°
$\alpha,\alpha'(\theta)$ suggests collective excitation
Levels at 4.8, 6.8 not seen
†Relative intensity at 70°

G.W.Parwell, D.D.Kerlee, Bull. Am. Phys. Soc. 1, No. 1, 20, DA5 (1956); verbal report.

Levels $Be^9(p,p')$ $E_p = 31.3$; p,p'(θ)

Level	l*	Level	l*
g.s.	1, (2?)	7.94 *8*	3
2.46 *5*	1(2?)	11.3 *2*	
5.0 *3*		19.9 *1*	0
6.76 *6*	1**	21.7 *1*	0 or 1

*l of Austern, Butler, McManus theory
**If level is double, $l = 1$ for 6.2, 2 for 6.8
3 pc differential range spectrometer

J.Benveniste, R.G.Finke, E.A.Martinelli, Phys. Rev. 101, 655 (1956).

Levels $Be^9(p,p')$ $E_p = 12$
$Be^9(d,d')$ $E_d = 24$
$Be^9(\alpha,\alpha')$ $E_\alpha = 48$
~1† 1.8 ?
100† 2.43 $l_x = 1$ $xx'(\theta)$

R.G.Summers-Gill, Phys. Rev. 100, 1795A (1955).

Level $Be^9(p,p')$ $E_p = 10$
(2.43) $l_p = 0$ p,p'(θ)

S.W.Rasmussen, Phys. Rev. 103, 186 (1956).

$Be^{9}_{4\ 5}$ Level $Be^{9}(d,d')$ $E_d = 9$; s 25°
d,d'(θ) for 2.43 level lacks forward peak
No 1.8, 3.2, 4.9 levels

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

Level $Be^{9}(n,n')$ $E_n = 3.7$
(2.43) decays to Be^{8} + n scin

J.M.Fowler, S.S.Hanna, G.E.Owen, Phys. Rev. 98, 249A (1955).

$Be^{9}(n,n'\gamma)$ $E_n = 2.56, 2.74$
No γ's observed [$\sigma(95°) < 0.03$ mb/sterad] scin

R.B.Day, Phys. Rev. 102, 767 (1956).

Levels	$B^{(11)}(d,\alpha)$	$E_d = 7$
	$Be^{9}(p,p')$	$E_p = 7$
	2.43	s
	3.04 $\Gamma \geq 0.28$	

C.K.Bockelman, A.Lévêque, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 6, 280 B1 (1956).

$Be^{10}_{4\ 6}$ Yield in $U^{235}(n,f) \leq 4 \times 10^{-4}$%
2.5×10^{6}y K.F.Flynn, L.E.Glendenin, E.P.Steinberg, Phys Rev. 101, 1492 (1956).

$Be^{10}_{4\ 6}$ Levels $Be^{9}(d,p)$ $E_d = 9$ s; d,p(θ)

Level	l_n
g.s.	1
(3.37)	1
(5.96)	0
(6.26)	0
(7.37)	1

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

Level $Be^{9}(n,n)$ $E_n = 0.53$ to 0.9
$\Gamma = 0.008$ (7.37) $J = 2^+$ or 3^+ $\sigma(E,\theta)$

R.O.Lane, J.E.Monahan, Bull. Am. Phys. Soc. 1, No. 4, 187 K1 (1956); verbal report.

$B^{9}_{5\ 4}$ Level $B^{(10)}(d,t)$ $E_d = 7$
g.s. $Q = -2.187$ *10* s

C.K.Bockelman, A.Lévêque, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 6, 280 B1 (1956).

Levels	$B^{10}(p,d)$	$E_p = 18.9$
	g.s. $l_n = 1$	p,d(θ)
	2.41 *15* $l_n = 1$	

J.B.Reynolds, K.G.Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

$B^{9}_{5\ 4}$ Levels $Be^{9}(p,n)$ $E_p = 2.0$ to 5.5; VdG
1.4* ? $\Gamma \sim 1$ thresh n, ~0°
2.327 5 Q = -4.178 5
*Also attributable to 3-body break-up
$\sigma(E_p = 2.52) = 11$ mb/sterad

J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955).

$B^{10}_{5\ 5}$ Level $B^{11}(p,d)$ $E_p = 18.9$
g.s. $l_n = 1$ p,d(θ)

J.B.Reynolds, K.G.Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

Levels	$Li^{7}(\alpha,n)$	$E_\alpha \sim 8$
	g.s. $Q = -2.82$ *10*	
	0.74 *6*	p recoil,
	1.31 *6*	thresh n; ~0°
	1.72 *6*	

A.B.Robbins, Phys. Rev. 101, 1373 (1956); 100, 1549A (1955).

Level $B^{10}(n,n'\gamma)$ $E_n = 2.56$; scin
γ 0.717 *7* $\sigma(95°) = 2.5$ *3* mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Level $Be^{9}(d,n)$ time of flight
(0.72) $\tau = 790^{\mu\mu s}$ *200*

J.C.Severiens, S.S.Hanna, Phys. Rev. 100, 1254A (1955); verbal report.

Levels $Be^{9}(p,n)$ $E_p = 2.0$ to 5.5
8.89 2 long counter,
10.80 *3* broad ~0°
W 11.03 *3*

J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955).

Levels $Be^{9}(p,n)$ $E_p = 2$ to 5, 0°, 90°

$\int \sigma d\theta$	Level	Γ	long counter
0.101	8.891 *6*	0.085 *10*	
	9.5	0.7	p,n(θ) at five E_p's
	10.8		

$Be^{9}(p,\alpha+3.6\gamma)$ $E_p = 2.0$ to 2.9
8.891 4 0.038 *3* scin, 90°

Suggests 8.89 level is double; J = 3, T = 1 level involved in (p,n); J = 2, T = 1 in (p,α+3.6γ)

J.B.Marion, Phys. Rev. 103, 713 (1956).

$B^{11}_{5\ 6}$ Levels $Be^{9}(He^{3},p_0)$ $E_{He^3} = 2$; ppl
Graphs of $He^{3},p_0(\theta)$; $He^{3},p_1(\theta)$; $He^{3},p_2(\theta)$; $He^{3},p_3(\theta)$ show no symmetry about 90°

H.D.Holmgren, W.E.Kunz, M.L.Bullock, Phys. Rev. 100, 436, 1253A (1955).

$B^{11}_{5\ 6}$

Level $B^{10}(d,p+2.14\gamma)$ $E_d = 1.20$
(2.14) $J = 1/2$ $p\gamma(\theta)$
$p(2.14\gamma)(\theta)$ is isotropic ($\pm 3.5\%$)

S. Gorodetzy, A. Gallmann, M. Croissiaux, R. Armbruster, Compt. rend. 242, 2545 (1956); J. phys. radium 17, 550 (1956).

Level $B^{11}(p,p'\gamma)$ $E_p = 2.0$ to 5.3
(2.14) $J = 1/2(\overline{3/2}?)$ $p,\gamma(\theta)$

J. K. Bair, J. D. Kington, H. B. Willard, Phys. Rev. 100, 21 (1956).

Levels $Li^{(7)}(\alpha,n)$ $E_\alpha = 4.1$ to 5.8
2.5* 11.69 thresh n, $\sim 0°$
3.4* 11.95 $\Gamma = 0.24$
*$\sigma(0°)$ in mb/sterad

H. Bichsel, T. W. Bonner, Bull. Am. Phys. Soc. 1, No. 2, 93, M5 (1956).

Levels* $Be^9(d,d)$ $E_d = 1.02$ to 1.44
16.769 $\Gamma \sim 0.07$ 90° to 160°
17.021 $\Gamma \sim 0.12$ ppl
*Increases in σ_{el}/σ(Rutherford) found

M. K. Jurić, S. D. Cirilov, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 45 (1956).

Reactions observed $E_n = 12$ to 20; ppl
$B^{10}(n,\alpha)Li^7$(4.61 level) $\longrightarrow \alpha + t$
$B^{10}(n,d)Be^9$(2.43 level) $\longrightarrow n + Be^8$(g.s. and 2.9 levels $\longrightarrow 2\alpha$
$B^{10}(n,\alpha)Li^7$(10.8 and 12.4 levels) $\longrightarrow n +$ Li^6(2.19 level) $\longrightarrow d + \alpha$

Reactions not observed
$B^{10}(n,t)Be^8$(g.s. or 2.9 level) $\longrightarrow 2\alpha$
$B^{10}(n,n')B^{10} \longrightarrow d + 2\alpha$

$\sigma(n,t\ 2\alpha)$ and $\sigma(n,d\ n'\ 2\alpha)$ given as $f(E_n)$

G. M. Frye, Jr., J. H. Gammel, Phys. Rev. 103, 328 (1956).

$B^{12}_{5\ 7}$ 0.03^s

β^- 17† (8.94) pc, scin $\beta\gamma$
1000† (13.37)
No γ with $3.3 < E_\gamma < 4.5$ ($< 4 \pm 20$†)
Li^8 comparison $B^{(11)}(d,p)$, pulsed beam

N. W. Tanner, Phil. Mag. 1, 47 (1956).

$\beta(4.4\gamma)/\beta = 0.013$ 4 scin
$\beta(3.2\gamma)/\beta \leq 0.002$ $\beta(7.6\gamma)/\beta \leq 0.002$
Conclude $J = 1$ for B^{12} g.s.

C. A. Barnes, R. W. Kavanagh, Phys. Rev. 100, 1796A (1955).

α $\sim 1\%$ 0.195 $B^{11}(d,p)$; s
Presumably from C^{12} 7.65 level to Be^8 g.s.

W. A. Fowler, C. W. Cook, C. C. Lauritsen, T. Lauritsen, F. Mozer, Bull. Am. Phys. Soc. 1, No. 4, 191 M2 (1956).

$B^{12}_{5\ 7}$

Level $Be^9(\alpha,p)$ $E_\alpha = 21.6$
3.38 s
p's to this level previously interpreted as d's

V. K. Rasmussen, D. W. Miller, M. B. Sampson, U. C. Gupta, Phys. Rev. 100, 851 (1955); *W. O. McMinn et al., Phys. Rev. 84, 963 (1951).

$B^{13}_{5\ 8}$

Level $Li^7(Li^7,p)$ $E_{Li^7} = 1.61$
g.s. $Q = 5.97$ 3 scin 90°

S. K. Allison, P. G. Murphy, E. Norbeck, Jr., Phys. Rev. 102, 1182 (1956).

$C^9_{6\ 3}$

$C^9 \rightarrow \beta^+ + \nu + p + \alpha + \alpha + Q$, $Q > 15.4$ from tracks found in ppl exposed to 3-Bev p's.
$8408.6 < \text{Mass } C^9 < 8409.6$ Mev

M. S. Swami, J. Schneps, W. F. Fry, Phys. Rev. 103, 1134 (1956).

$C^{11}_{6\ 5}$

Level $B^{(11)}(p,n)$ $E_p = 7.03$
25† g.s. $Q = -2.83$ 8 4 angles
10† 2.01 6 ppl
$\sigma(0°)/\sigma(20°) \sim 2.5$ for both levels
g.s. $\sigma(0°) = 13^{+13}_{-7}$ mb/sterad. †At all 4 angles

F. Ajzenberg-Selove, G. D. Johnson, A. Rubin, M. Mazari, Phys. Rev. 103, 356 (1956).

Levels $C^{(12)}(p,d)$ $E_p = 95$
st g.s.
~ 4.5

W. Selove, Phys. Rev. 101, 231 (1956).

Levels $B^{10}(p,\gamma)$ $E_p = 0.5$ to 2.0
σ Level scin
g.s. $Q = 8.81$ 10
3.5 10 μb 9.729 15 $\Gamma = 0.54$ 4
$p,(9.73\gamma)(\theta) = 1 + (0.50\ 5)\cos^2\theta$

$B^{10}(p,\alpha+0.43\gamma)$ $E_p = 0.6$ to 2.0
0.21 5 b 10.09 scin
$p,(0.43\gamma)(\theta) \sim$ isotropic ($\pm 2\%$)

G. B. Chadwick, T. K. Alexander, J. B. Warren, Can. J. Phys. 34, 381 (1956).

Levels $B^{10}(d,n)$ $E_d = 0.35$ to 4.5; VdG
0.18† 8.107 8 thresh n, $\sim 0°$
1.0† 8.430 8
1.6† 8.660 8
No n thresholds observed corresponding to levels at 6.87, 7.39, 8.97, 9.13, 9.70, 10.06
Graph of $\sigma(\sim 0°)$ given for n yield
†Relative intensities at thresholds, 0°

J. B. Marion, T. W. Bonner, C. F. Cook, Phys. Rev. 100, 847 (1955).

$C^{11}_{6\ 5}$

Levels $B^{10}(p,\alpha)$ $E_p = 0.8$ to 1.8

Level	J	Γ	
• 9.7	$5/2^+$	>0.30	sd, 46°
10.1	$5/2^-$	~0.20	
background	$3/2^-$		

H.R. Allen, M. Govindjee, N. Sarma, Proc. Phys. Soc. 69A, 350 (1956).

Levels $B^{10}(p,\alpha)$ $E_p = 0.8$ to 1.8

σ_{α_0}	σ_{α_1}	Level	J	Γ	EA
0.21 4		9.7	$3/2^-$	0.30	$p, \alpha(\theta)$
0.23 4	~0.13	10.1	$7/2^+$	0.25	

J.W. Cronin, Phys. Rev. 101, 298 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA7 (1956).

$C^{12}_{6\ 6}$

Levels $C^{(12)}(p,p')$ $E_p = 96$

100†	g.s.	scin $p,p'(\theta)$
~5†	4.4	
	9.6	
	20.8 7	

Inelastic peak energies are constant in c.m. system ∴ final states involve whole nucleus

K. Strauch, F. Titus, Phys. Rev. 103, 200 (1956); 95, 854 (1954).

Levels $C^{(12)}(\alpha,\alpha')$ $E_\alpha = 22$

g.s.		s
(4.43)		
7.64 7	Γ_α/Γ	>0.8*
(9.6)		
(12.7) ?		

*From absence of C recoils

$\alpha,\alpha'(\theta)$ not symmetric about 90° c.m.

V.K. Rasmussen, D.W. Miller, M.B. Sampson, Phys. Rev. 100, 181 (1955).

Levels $B^{10}(\alpha,d)$ EA

g.s. Q = 1.3405 10

$N^{(14)}(d,\alpha)$ EA

(9.64) Q = 3.928 11 Γ~0.035

R. Chiba, R.A. Douglas, J.W. Broer, D.F. Herring, E.A. Silverstein, Phys. Rev. 100, 1253A (1955); verbal report.

Level $C^{(12)}(n,n'\gamma)$ $E_n = 6.58$; scin

γ 4.42 3 $\sigma(95°) = 28$ 5 mb/sterad

R.B. Day, Phys. Rev. 102, 767 (1956).

Level $Be^9(\alpha,n)$ $E_\alpha = 2$

(4.43) $\tau = 1.8 \times 10^{-14}$s 6

From Doppler shift. Stopping power estimated.

S. Devons, G. Manning, J.H. Towle, Proc. Phys. Soc. 69A, 173 (1956).

$C^{12}_{6\ 6}$

Level $C^{(12)}(d,d')$ $E_d = 9$; s

$d,d'(\theta)$ for 4.43 level lacks forward peak

T.S. Green, R. Middleton, Proc. Phys. Soc. 69A, 28 (1956).

$Be^9(\alpha,n\gamma)$ $E_\alpha = 5.30$

$n\gamma(\theta)$ isotropic (4.43 γ predominates)

$\eta = 0.000$ 65

K.G. Steffen, O. Hinrichs, H. Neuert, Z. Physik 145, 156 (1956).

Levels $Be^9(\alpha,n\gamma)$ $E_\alpha \leq 4.3$

3mb*	4.48 6	sl pr
(7.6)	$\Gamma_\alpha/\Gamma > 0.96$**	

**From absence of prs from 7.6 level to g.s. and 4.5 level (<5% of prs from 4.5 level)

*Average σ for $E_\alpha = 0$ to 4.3

R.D. Bent, T.W. Bonner, J.H. McCrary, W.A. Ranken, Phys. Rev. 100, 771 (1955).

Levels $B^{10}(He^3,p)$ $E_{He^3} = 1.25$

400†	(4.43)	scin
10†	(7.6)	

No level between 4.43 and 7.6 (<1†)

C.D. Moak, A. Galonsky, Bull. Am. Phys. Soc. 1, No. 4, 196 N8 (1956); verbal report.

Levels $Be^9(\alpha,n)$ $E_\alpha = 1.25$

(4.43)	4.43γ is E2	scin, $e^+e^-(\theta)$
	$B^{(11)}(p,\gamma)$	$E_p = 0.680, 1.390$
(16.57)	12.14γ is E1	scin,
(17.22)	17.22γ is E1	$e^+,e^-(\theta)$

S. Gorodetzky, R. Armbruster, P. Chevallier, A. Gallmann, Compt. rend. 242, 898 (1956); J. phys. radium. 17, 548 (1956).

Level $Be^9(\alpha,n)$ $E_\alpha = 5.3$

(7.6)

No prs observed from 7.6 level (< 0.3% of prs from 4.4 level)

G. Goldring, R. Wiener, Y. Wolfson, Bull. Research Council Israel 5A, 87A (1955).

Level $N^{14}(d,\alpha)$ $E_d = 0.855$; sd 61°,

7.658 27 Q = 5.912 13 135°

Assumed g.s. Q = 13.570 24

K. Ahnlund, Arkiv Fysik 10, 369 (1956).

Level $N^{14}(d,\alpha)$ $E_d = 0.855$

7.660 28 Q = 5.910 15 sd

Assumed g.s. Q = 13.570 24

R.T. Pauli, Arkiv Fysik 9, 571 (1955).

$C^{12}_{6\ 6}$ Levels $B^{11}(d,n)$ $E_d = 1.0$ ppl 0°,90°

12.0 *1*
12.9 *1*
13.6 *1*
13.9 *1*

12.9 level not observed at 90°

E. Kondaiah, Proc. Indian Acad. Sci. 43A, 130 (1956).

$C^{(12)}(\gamma,3\alpha)$ $E_\gamma \leq 40$; ppl $\gamma,\alpha(\theta)$

E_γ		Be^8 levels*
13.0 to 15.6	E2	g.s. 2500 stars
	E2, M1	2.9
15.6 to 25	E1, E2	2.9, 4.0, g.s., 6 and 10, 15
>25	E1	16.8, 17.6, 6 and 10 2.9 and 4, 15, g.s.

*In order of observed frequency. See Be^8

Level 21.9 $J = 2\dagger$ $T = 0$
Only level of previous work to which spin could be assigned

F.K. Goward, J.J. Wilkins, Proc. Roy. Soc. 228, 376 (1955).

Level $C^{(12)}(\gamma,\gamma)$
15.0 2 $\Gamma \sim 100$ ev $\Gamma_\gamma/\Gamma > 0.5$

E.G. Fuller, E. Hayward, N. Svantesson, Bull. Am. Phys. Soc. 1, No. 1, 21, DA8 (1956); verbal report.

Level $B^{(11)}(d,n)$ $E_d = 1.0$ to 5.5; VdG
15.100 *6* thresh n, ~0°
Graph of $\sigma(\sim 0°)$ given for n yield

J.B. Marion, T.W. Bonner, C.P. Cook, Phys. Rev. 100, 847 (1955).

Level $B^{(11)}(d,n\gamma)$ $E_d = 1.6$ to 3.3
15.106* *3* No α observed; scin
*From threshold for $\sim 15\gamma = 1.633$ *3*
12.8 γ observed at $E_d = 1.63$**

C.A. Barnes, R.W. Kavanagh, Phys. Rev. 100, 1796A (1955); **verbal report.

Levels $B^{(11)}(p,\alpha_i)2\alpha_j$ $E_p = 0.163, 0.290$
(16.10) $J = 2^-$ $\alpha_i\alpha_j(\theta)$
(16.57) $J \neq 2^-, 3^{+*}$, $J = 2^{+*}$
(17.22) $J \neq 1^{-*}$
*Assuming single level is responsible for $\alpha_i\alpha_j(\theta)$ for $E_p = 0.290$. Results also explainable by mixture, 16.57 (2^-), 17.22 (1^-)

E.H. Geer, E.B. Nelson, E.A. Wolicki, Phys. Rev. 100, 215; 98, 241A (1955).

$C^{12}_{6\ 6}$ Level $B^{(11)}(p,p)$ $E_p = 0.6$ to 2.0
(16.57) $J = 2^-$ sπ 152°
Spin assignment is consistent with σ measurement if there is no overlapping with 17.22 level

G.W. Tautfest, S. Rubin, Phys. Rev. 103, 196 (1956).

Levels $B^{11}(p,\gamma_o$ or $\gamma_1)$ $E_p = 2.0$ to 5.3
$B^{11}(p,n)$ VdG 0°,90°
$B^{11}(p,p'\gamma_j)$ scin, long counter

Γ	Level	n	γ_o	γ_1	γ_j
0.3	18.3	--	st	w	--
0.046	18.39	--	--	--	st
0.1	18.84	st	st	w	st
0.5	19.2	st	st	st	st
0.05	19.41	--	--	--	st
0.2	19.66	st	--	--	--
0.1	19.87	--	w	--	st
0.2	20.25	st	--	--	st
0.2	20.48	--	st	--	--
0.2	20.64	--	st	--	st

J.K. Bair, J.D. Kington, H.B. Willard, Phys. Rev. 100, 21 (1955).

Levels* $C^{(12)}(\gamma,n)20^m C^{11}$ $E_\gamma \leq 20$
19.10 5
19.55 5
*Sharp peaks in activation curve

B.M. Spicer, A.S. Penfold, Phys. Rev. 100, 1375 (1956).

Levels $C^{(12)}(\gamma,3\alpha)$ $E_\gamma \lesssim 27, \lesssim 33$
Distribution of C^{12} excitation energies calc. from 485 stars. Levels not clearly resolved.

F.I. Havliček, B. Dobovišek, Phys. Rev. 100, 1355 (1955).

$C^{13}_{6\ 7}$ Level $C^{(12)}(d,p)$ $E_d = 2.68, 3.26$
19, 13† g.s.
†σ(peak) for above E_d respectively. σ's for C^{13}, N^{13} show g.s. reduced widths ~ same.

R.E. Beneson, K.W. Jones, M.T. McEllistrem, Phys. Rev. 101, 308 (1956).

Level $C^{(12)}(d,p)$ $E_d = 0.262$ to 0.585
g.s. ppl
Values given of $a_1 - a_4$ in $\Sigma a_i P_i(\theta)$ for d,p(θ)
$\int \sigma d\theta$ increases with E_d from 0.6 to 9.9 mb
Values differ slightly from those of Valckx* obtained with scin

B. Koudijs, Thesis, University of Utrecht (1956); *P.P.G. Valckx, Thesis, University of Utrecht (1956).

$C^{13}_{6\ 7}$

Level $C^{(12)}(d,p)$ $E_d = 0.60$ to 1.45

g.s. ppl

Values given of $a_o \cdots a_5$ in $\Sigma a_i P_i(\theta)$ for $d,p(\theta)$

M.K.Juric, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 35 (1956).

Level $C^{(12)}(d,p)$ $E_d = 1.43$ to 1.95

g.s. ppl

Graphs of $d,p(\theta)$ given

F.Alba, T.A.Brody, A.Fernández, M.Mazari, V. Serment, M.Vasquez, Anales Inst. Fisica Mexico 1, 1 (1955); Rev. Mexicana Fiz 4, 207 (1955).

Levels $C^{(12)}(d,p)$ $E_d = 8.9$ d,p(θ)

Level	l_n	θ^2
g.s.	1	0.07
(3.09)	0	0.21
(3.68)	1	0.02
(3.86)	2	0.14

F.A.El Bedewi, Proc. Phys. Soc. 69A, 221 (1956).

Levels $C^{(12)}(d,p)$ $E_d = 9$ s; $d,p(\theta)$

θ^2	Level	l_n
0.05	g.s.	1
0.27	3.090	0
0.016	3.684	1
0.06	3.855	2

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

γ $B^{(10)}(\alpha,p\gamma)$ $E_\alpha = 2.3$

$C^{(12)}(d,p\gamma)$ $E_d = 2.4$

0.1695 4 $\alpha = 0.00014^*$ 3 sl ce,pe

3.67 3 $\tau < 0.3^{\mu\mu}s$ } Doppler shift

3.844 15 $\tau < 0.3^{\mu\mu}s$ }

No$\sim$0.6γ (<3% of 3.67γ+3.84γ) sl pe

γ and p intensities show that for 3.84 level (decays to 3.67 level)/(decays to g.s.) = 0.24

*Assuming isotropy

R.J.Mackin, Jr., W.R.Mills, Jr., J.Thirion, Phys. Rev. 102, 802 (1956); J. phys. radium 17, 551 (1956); Phys. Rev. 92, 529A (1953).

Levels $B^{10}(\alpha,p)$ $E_\alpha = 8.1$

100†	g.s.	Q=4.08 3	scin,90°
60†	3.07 5		
600†	3.86 5		

No 0.7 level (<7†)

G.F.Pieper, G.S.Stanford, Phys. Rev. 101, 672 (1956).

$C^{13}_{6\ 7}$

Levels $C^{12}(d,p)$ $E_d = 14.8$; s d,p($10^\circ < \theta < 87^\circ$)

		l_n		
26†	g.s.	1	9.6††	7.53 2
103†	3.09	0	7.5††	7.64* 2
16†	3.68	1	100††	8.4** 3
152†	3.86	2	1.6††	9.50 2
3.6††	6.87	0,2	2.2††	9.90 2
0.8††	7.47 2		5.5††	10.76 2

d,p(θ) shows forward peak for all except 9.50 level for which distribution is isotropic

†,†† mb/sterad at † max or at †† 10°

*$\Gamma = 0.070 \pm 0.015$ **$\Gamma = 1.1 \pm 0.3$

J.N.McGruer, E.K.Warburton, R.S.Bender, Phys. Rev. 100, 235 (1955).

Level $C^{(12)}(n)$ $E_n = 0.66$ to 2.15

(6.87) $\Gamma = 0.011$ $J = 3/2$ σ_t

n,n(θ) shows d-wave involved

J.E.Wills,Jr., Bull. Am. Phys. Soc. 1, No. 4, 175 F3 (1956).

Levels $C^{(12)}(n)$ $E_n = 4.4$ to 5.5, 7.6 to 8.6

9.33

9.52 $J > 1/2$? σ_t

R.L.Becker, H.H.Barschall, Phys. Rev. 102, 1384 (1956); 99, 1646A (1955).

Levels $C^{(12)}(n,n'\gamma)$ $E_n = 4.4$ to 8 scin 4.4γ

10.77

10.94

11.97

12.21

H.E.Hall, T.W.Bonner, Bull. Am. Phys. Soc. 1, No. 2, 96, N10 (1956).

Levels $Be^9(\alpha,n\gamma)$ $E_\alpha = 1.5$ to 5.3 BF_3, scin γ

σ_n^*	$\sigma_{4.4\gamma}^{**}$	Level$	Γ
25	14	12.0	0.2
15		12.2	$\sim$0.2
20	4.7	12.5	$\sim$0.2
79	20	13.41	0.06
60	18	13.7	$\sim$0.4
87	23	14.1	$\sim$0.3

*mb/sterad, 0° to 20° **mb/sterad, 0° to 10°

$Not corrected for Coulomb barrier penetration

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

Levels $Be^9(\alpha,n)$ $E_\alpha = 1.7$ to 5.1

Level	n group	Γ
12.45	n_o(st), n_1(w)	
13.5	n_1(st)	small
13.5 to 13.8	n_o, n_1	large

α,n(θ) shows forward peaking

J.R.Risser, C.M.Class, J.E.Price, Bull. Am. Phys. Soc. 1, No. 1, 20, DA4 (1956).

$C^{13}_{6\ 7}$

Levels $Be^9(\alpha, n_o)$ $E_\alpha = 2.5$ to 5

Level	J	
12.45		$\alpha, n(\theta)$
~13.5	$5/2^+$	
13.7	$3/2^+$	
>14	$7/2^+$	

J.R.Risser, Bull. Am. Phys. Soc. 1, No. 2, 93 M4 (1956).

Resonance $C^{13}(\gamma, n)$ $E_\gamma \leq 45$ BF_3

peaks 4* 14.5 $\Gamma = 4$

9.5* 24 $\Gamma = 8$

*σ(peak) in mb

B.C.Cook, V.L.Telegdi, Bull. Am. Phys. Soc. 1, No. 1, 63, UA11 (1956); verbal report.

Levels $B^{(11)}(d, n+15.1\gamma)$ $E_d \leq 3.3$

$\sigma = 17$mb 20.51 ? Sharp decrease in slope

21.27 Weak resonance, $\Gamma \sim 0.18$

C.A.Barnes, R.W.Kavanagh, Phys. Rev. 100, 1796A (1955).

Levels $B^{11}(d, n_o)$ $E_d = 3.5$ to 5

22 to 23 J = 7/2 $d, n_o(\theta)$

J.E.Price, C.M.Class, J.R.Risser, Bull. Am. Phys. Soc. 1, No. 2, 94, M10 (1956).

$C^{14}_{6\ 8}$

Level $C^{13}(d, p)$ $E_d = 0.288$ to 0.641

g.s. $l_n = 1$ ppl

Values given of $a_1 \cdots a_4$ in $\Sigma a_i P_i(\theta)$ for $d, p(\theta)$

Stripping predominates

$\int \sigma d\theta$ increases with E_d from 0.07 to 4.1 mb

B.Koudijs, Thesis, Univ. of Utrecht (1956); B.Koudijs, F.P.G.Valckx, P.M.Endt, Physica 19, 1133 (1953). The higher (by a factor of ~5) values of $\int \sigma d\theta$ given in the thesis are due to a new analysis of the C^{13} content.

Level $C^{13}(d, p)$ $E_d = 0.6$ to 3.0

g.s. scin

Values given of $a_o \cdots a_4$ in $\Sigma a_l \cos^l(\theta)$ for $d, p(\theta)$

Compound nucleus formation predominates for $E_d < 1.7$

$\int \sigma d\theta$ increases with E_d from 7.2 *4* to 26.3 *13* mb, maximum at $E_d = 1.40$ *4*.

J.B.Marion, G.Weber, Phys. Rev. 103, 167 (1956).

Level $C^{(13)}(d, p)$ $E_d = 8.9$

(6.09) $l_n = 0$ $d, p(\theta)$

$\theta^2 = 0.32$

F.A. El Bedewi, Proc. Phys. Soc. 69A, 221 (1956).

$C^{14}_{6\ 8}$

Levels $C^{13}(d, p)$ $E_d = 14.8$; s

			l_n	d, p(10° < θ < 87°)	
10†	g.s.		1	7.1†† 9.80	2
62†	6.09		0	~1.9†† 10.43	2
1.6†	6.59	2	0,2	1.4†† 10.50	2
74†	6.72		2	90†† 11.9**	3
22†	6.89		1	6.3†† 12.60*	2
56†	7.35	2	2	1.0†† 12.85	2
2.2††	8.32	2		1.9†† 12.96	2

d, p(θ) shows forward peak for all levels

†, †† mb/sterad at † max or at †† 10°

*$\Gamma = 0.13 \pm 0.02$ **$\Gamma = 1.1 \pm 0.3$

J.N.McGruer, E.K.Warburton, R.S.Bender, Phys. Rev. 100, 235 (1955).

Levels $C^{13}(d, p\gamma)$ $E_d = 4.1$

(6.1) E1γ(assumed) sl pr

(6.7) E2γ(or E1, M1, E3)*

*From (ext 6.7 prs)/(ext 6.1 prs) = 0.51 ± 0.04

(int 6.7 prs)/(int 6.1 prs) = 0.47 ± 0.03

R.D.Bent, T.W.Bonner, J.H.McCrary, W.A. Ranken, Phys. Rev. 100, 771 (1955).

$C^{15}_{6\ 9}$ 2.4^s

τ		2.25^s	C^{14}(≥1.3-Mev d,p)
β^-	80%	4.3	Compared to thick
	20%	9.8	Pr^{144} source scin
$\gamma(N^{15})$	100†	5.3	

No 1.9 γ (<10†) No other γ (<5†)

R.A.Douglas, B.Gasten, J.Downey, A.Mukerji, Bull. Am. Phys. Soc. 1, No. 1, 21, DA13 (1956); verbal report; Phys. Rev. 100, 1253A (1955).

$C^{14}(d, p)2.4^s C$ $E_d = 0.6$ to 3.0

Previously reported activity for $E_d < 1.3$ ascribed to $O^{18}(d, \alpha)7.4^s N^{16}$, i.e. $Q \neq 0.15$

N.A.Bostrom, E.L.Hudspeth, I.L.Morgan, Bull. Am. No. 2, 94, M12 (1956).

$N^{13}_{7\ 6}$ 10^m

τ 10.08^m *4* $C^{(12)}$(14.1-Mev d,n)

D.H.Wilkinson, Phys. Rev. 100, 32 (1955).

$N^{13}_{7\ 6}$

Level $C^{(12)}(d, n)$ $E_d = 2.68, 3.26$

32,31† g.s.

†σ(peak) for above E_d respectively. σ's for C^{13}, N^{13} show g.s. reduced widths ~ same.

R.E.Beneson, K.W.Jones, M.T.McEllistrem, Phys. Rev. 101, 308 (1956).

Level $N^{(14)}(p, d)$ $E_p = 18.7$

~5† g.s. $l_n = 1$ $p, d(\theta)$

2.37 level not seen [$\sigma(14°\text{c.m.}) < 0.4$ mb/sterad]

†σ(18°c.m.) in mb/sterad

K.G.Standing, Phys. Rev. 101, 152 (1956).

$N^{13}_{7\ 6}$

Level	$C^{(12)}(d,n)$	E_d = 2.8 to 3.9; VdG
2.37 2		thresh n, ~0°

Graph of $\sigma(\sim 0°)$ given for n yield

J.B.Marion, T.W.Bonner, C.P.Cook, Phys. Rev. 100, 847 (1955).

Levels	$B^{10}(\alpha,n)$	$E_\alpha \sim 8$
2.4 3		p recoil,
3.6 3		thresh n; ~0°
4.3 3 ?		
5.0 3		

g.s. Q of 1.1 assumed

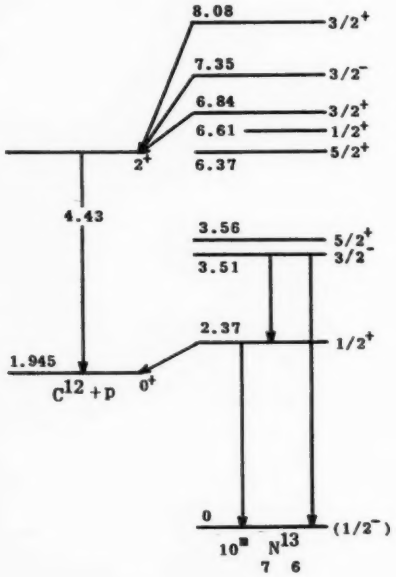
A.R.Quinton, W.T.Doyle, Phys. Rev. 101, 669 (1956).

Levels	$C^{(12)}(p,p)$			E_p = 4.0 to 5.5
	Level	J	Γ	s
	6.371	$5/2^+$	0.012	p,p(θ)
	6.90	$3/2^+$	0.100	

C.W.Reich, G.C.Phillips, J.L.Russell, R.R. Henry, Bull. Am. Phys. Soc. 1, No. 2, 96, N9 (1956); verbal report.

Levels	$C^{(12)}(p,p)$			E_p = 4.7 to 7.0
	$C^{(12)}(p,p'+4.43\gamma)$			a p,p(θ)
$\sigma_{pp'}/\sigma_{pp}$	Level	J	Γ	θ^2
0.00	6.61	$1/2^+$	0.075	0.0144
0.056	6.84	$3/2^+$	0.050	0.024
0.024	7.35	$3/2^-$	0.050	0.011
0.02	8.08	$3/2^+$	0.350	0.11

p(4.43γ)(θ) is isotropic (±10%)
p,p'(θ) is isotropic (E_p = 7, θ = 80 to 160°)*



H.Schneider, Helv. Phys. Acta 29, 55 (1956); *J. de Boer ibid.

$N^{14}_{7\ 7}$

Levels	$B^{11}(\alpha,n)$		$E_\alpha \sim 8$
g.s.	Q = 0.0 3		p recoil,
2.0 3			thresh n; ~0°
3.15 30			
3.85 30			
4.8 3			

A.R.Quinton, W.T.Doyle, Phys. Rev. 101, 669 (1956).

Level	$N^{(14)}(n,n'\gamma)$	E_n = 3.95; scin
γ	2.30 5	σ(95°) = 0.5 3 mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Level	$N^{(14)}(p,p'\gamma)$	E_p = 19
γ	(2.31) $\tau < 0.35^{\mu\mu s}$	scin

Doppler effect ΔE/E ~ 0.009 (~ maximum possible)

R.Sherr, J.B.Gerhart, H.Horie, W.F.Hornyak, Phys. Rev. 100, 945 (1955).

Level	$O^{(16)}(d,\alpha)$	E_d = 5.5 to 7.5
2.31		sπ 5 angles

Weak α group to this level established

C.P.Browne, Phys. Rev. 100, 1253A (1955); verbal report.

Levels	$N^{(14)}(d,d')$	E_d = 9, s 40°
3.95		
4.92		
5.10		

d,d'(θ) for 3.95 level has forward peak

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

Levels	$N^{(14)}(\alpha,\alpha')$	E_α = 21.5
3.95 4		sπ several angles
5.12 7		
5.79 7	7.94 7	
6.47 9	8.45 7	
7.01 6	10.05 7	

2.31, 7.40, 7.72, 8.06, 9.49 levels not observed

D.W.Miller, B.M.Carmichael, U.C.Gupta, V.K. Rasmussen, M.B.Sampson, Phys. Rev. 101, 740 (1956).

Level	$C^{13}(d,n)$	E_d = 0.4 to 4.2; VdG
5.683 7	$J = 1^{+*}$	thresh n,

*Slow rise suggests p-wave n's ~0°
Graph of σ(~0°) given for n yield

	$C^{(12)}(d,n)$	E_d = 2.8 to 3.9; VdG
13.16	$J = 0^-, 1^{-**}$	

**Increase of fast n's implies s-wave to g.s.
Graph of σ(~0°) given for n yield

J.B.Marion, T.W.Bonner, C.P.Cook, Phys. Rev. 100, 847 (1955).

$N^{14}_{7\ 7}$

$C^{(12)}(He^3,p\gamma)$

6.01 excitation $E_{He^3} = 1.55$

γ	100†	(1.64)	10% P_2 term	scin $p\gamma(\theta)$
		(2.31)	spherical symmetry	
	4.3±0.8†	(3.95)		
		(4.91)		

H.E.Gove, A.E.Litherland, E.Almqvist, D.A. Bromley, Phys. Rev. 103, 835 (1956); Bull. Am. Phys. Soc. 1, No. 4, 196 N3 (1956).

Level $C^{13}(p,\gamma)$ $E_p = 1.16$

(6.23) $J = 1$

$(2.4\gamma)(6.23\gamma)(\theta)$ $J = 0,\ 1,\ 1$

S.Gorodetzky, A.Gallmann, M.Croissiaux,, R. Armbruster, Compt. rend, 242, 2545 (1956); J. phys. radium 17, 550 (1956).

Level $C^{13}(p,\gamma)$

8.06 level $E_p = 0.550$

γ	100†	(1.64)	100†	(4.11)
	140†	(2.31)	15†	(5.69)
	40†	(2.37)	15†	(5.75)
	5.5±1.0†	(3.95)		scin $\gamma\gamma$

†From study of $(4.11\gamma)(3.95\gamma)/(4.11\gamma)(1.64\gamma)$ and $(2.31\gamma)(5.75\gamma)/(2.37\gamma)(5.69\gamma)$

P.Lehmann, A.Lévêque, R.Pick, Compt. rend. 243, 743 (1956).

$N^{(14)}(\gamma,p)$ $E_\gamma = 8.06$

Observed resonant absorption by broad level at ~8.06 of γ's from same level produced by $C^{13}(p,\gamma)$

G.M.Griffiths, Can. J. Phys. 34, 339 (1956).

Levels $N^{(14)}(\gamma,p)$ $E_\gamma \leq 23$

σ(Mev-mb)	Level	
0.6	(8.06)	cc for p groups
0.8	(9.18)	n,p background
1.2	(10.43)	identified

σ's consistent with those for inverse reaction

I.P.Wright, D.R.O.Morrison, J.M.Reid, J.R. Atkinson, Proc. Phys. Soc. 69A, 77 (1956).

Levels $C^{13}(p,p)$ $E_p = 1.5$ to 3.4

9.39	several angles
9.51	10.29
9.70	10.43

D.Zipoy, K.Famularo, G.D.Freier, Bull. Am. Phys. Soc. 1, No. 1, 9, AB3 (1956).

Level $C^{(12)}(d,p)$ $E_d = 0.2$ to 0.7

10.57 scin 0°, 120°

P.P.G.Valckx, Thesis, University of Utrecht (1956).

$N^{14}_{7\ 7}$

Levels $C^{(12)}(d,d)$ $E_d = 2.4$ to 3.4

12.309	$J = 4^-$	170°
12.608	$J = 3^+$	

M.T.McEllistrem, Phys. Rev. 100, 1253A (1955).

Levels $C^{(12)}(d,p)$ VdG, scin

E_d	Level	E_d	Level
2.465	12.38	4.004	13.70
2.669	12.55		Γ = 150 kev
2.992	12.83	5.336	14.84
3.388	13.17	5.635	15.09

$d,p_0(\theta)$ for $E_d \simeq 3.0, 4.0, 4.75$ shows $l = 1$ pattern

$d,p_1(\theta)$ for $E_d \simeq 4.75$ shows $l = 0$ pattern

$C^{(12)}(d,n)$ long counter

3.01	12.84 *3*	3.95	13.65 *3*	
3.36	13.14 *3*	4.61	14.21 *3*	

$d,n_0(\theta), d,n_1(\theta)$ shows $l = 1$, $l = 0$ resp. for $E_d \sim 4$

T.W.Bonner, J.T.Eisinger, A.A.Kraus,Jr., J.B.Marion, Phys. Rev. 101, 209 (1956).

Levels $B^{10}(\alpha,n)$ $E_\alpha = 2$ to 5.5

$B^{10}(\alpha,p\gamma)$ BF_3, scin γ

σ_n^*	$\sigma_{3.7\gamma}^{**}$	Level	Γ
0.9	12	13.16	0.03
0.6	12	13.23	0.20
1.1	8.0	13.68	0.20
	8.7	14.2	0.40
	13	14.43	0.2
	14	14.85	0.2
24	11	15.08	~0.05
21	13	15.44	0.1

*mb/sterad, 0° to 20° **mb/sterad, 40° to 50°

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

(a) $C^{(12)}(d,n)10^mN^{13}$ $E_d = 20$

(b) $C^{(12)}(d,t)20^mC^{11}$ stacked

No resonances observed foils

Compound nucleus picture predicts for increasing E_d faster fall of σ(a), slower rise of σ(b) than observed

D.H.Wilkinson, Phys. Rev. 100, 32 (1955).

$N^{15}_{7\ 8}$

Levels $N^{(14)}(d,p)$ $E_d = 9$; s $d,p(\theta)$

$(2J+1)\theta^2$	Level	l_n	$(2J+1)\theta^2$	Level	l_n
0.03	(5.280), (5.305)	2	0.40	(8.316)	0
			0.03	(8.571)	1?
0.04	(6.330)	1	0.03	(9.062), (9.165)	1
0.32	(7.165)	2			
0.45	(7.314)	0	0.14	(10.069)	1
0.41	(7.575)	2	0.24	~11.2	1

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

$N^{15}_{7\ 8}$

Level	$O^{(16)}(\gamma,p\gamma)$	$E_\gamma \geq 21$
γ	(6.33)	scin
No other γ (<20% of 6.33γ)		See also O^{15}

N. Svantesson, Bull. Am. Phys. Soc. 1, No. 1, 28, GA3 (1956).

Levels	N^{14}(d,p)		EA
	(7.31)	Q = 1.308	*12*
	(7.58)	= 1.045	*12*
	(8.32)	= 0.2958	*6*
	(8.57)	= 0.038	*10*

R. Chiba, R. A. Douglas, J. W. Broer, D. F. Herring, E. A. Silverstein, Phys. Rev. 100, 1253A (1955); verbal report.

Capture γ's	$N^{(14)}$(th n,γ)			sπ pr
15†	3.520 *20*	17†	6.323 *8*	
17†	3.669 *16*	9†	7.305 *12*	
16†	4.497 *11*	4†	8.313 *13*	
22†	5.259 *8*	0.2†	8.34 *4*	
35†	5.288 *7*	0.2†	9.03 *3*	
18†	5.534 *8*	1†	9.145 *10*	
14†	5.543 *8*	12†	10.833 *8*	

No 7.164 γ (< 0.8†)
†Photons/100 N radiative captures

P. J. Campion, G. A. Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28, GA2 (1956); verbal report.

Levels	C^{14}(p,γ_o)		E_p = 0.2 to 1.7	
	C^{14}(p,n)		E_p = 0.9 to 2.5	
J	Level	Γ_n(kev)	Γ_p(kev)	Γ_{γ_o}(ev)
	10.544[1]			< 0.004
$3/2^-$	10.707			0.12
$3/2^-$	10.810			0.010
$1/2^-$	11.290	1.6	10.4	0.29
$1/2^+$	11.43	32.8	8.2	2.15
$1/2^+$	11.61[2]	5.0	470[3]	26.3
$3/2^+$	11.76	36.5	0.5	
$5/2^-$	11.88	24.5	0.03	
$1/2^-$	11.96	21.2	0.3	
$5/2^-$	12.09	17.2	0.8	
$3/2^+$	12.15	38.0	15.0	
$5/2^+$	12.33	21.7	0.3	

Authors suggest 10.458 or 10.06 level is responsible for $\sigma[N^{14}(\text{th n},\gamma)]$
[1]Strong 7.1 capture γ observed which is not seen in N^{14}(th n,γ) spectra
[2]Possibly T = 3/2 analog to C^{15} g.s.
[3]Accounts fully for $\sigma[N^{14}(\text{th n,p})]$
J values from p,$\gamma_o(\theta)$, p,n(θ), σ^*_{nn}, σ^*_{np}

G. A. Bartholomew, F. Brown, H. E. Gove, A. E. Litherland, E. B. Paul, Can. J. Phys. 33, 441 (1955); Phys. Rev. 95, 595, 649A (1954); 96, 823A, 1154 (1954); Can. J. Phys. 34, 147 (1956); *Hinchey et. al., Phys. Rev. 86, 483 (1952).

$N^{15}_{7\ 8}$

Levels	B^{11}(α,n)			E_α = 1.9 to 5.5		
	σ^*	Level	Γ(kev)	σ^*	Level	Γ(kev)
	23	12.50	59			
	11	12.90	90	16	13.72	40
	>8.9	13.14	<3	11	13.87	70
	17.7	13.17	~7	18	14.11	~10
	13	13.36	25	14	14.18	35
	14	13.59	20	24	14.66[$]	72

*mb/sterad, 0° to 20°
[$]Also observed in $B^{11}(\alpha,n+2.3\gamma)$

T. W. Bonner, A. A. Kraus, J. B. Marion, J. P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

Levels	C^{13}(d,p)	E_d = 0.23 to 0.7
	16.47	scin, 0°, 120°
	16.63	

F. P. G. Valckx, Thesis, University of Utrecht (1956).

Levels	C^{13}(d,p)		E_d = 0.6 to 3.0
7.2*	16.70		scin 20°, 135°
38*	17.35	Γ~0.4	
	18.08	Γ~0.05	
	18.3	Γ = 0.270 *70*	

Narrow level at 18.06 not found
Values not corrected for barrier penetration
*Peak σ in mb. σ's given for other E_d.

J. B. Marion, G. Weber, Phys. Rev. 103, 167 (1956).

Levels			E_d = 1 to 3
Γ(kev)	C^{13}(d,α_o)		C^{13}(d,t_o) sd
broad	17.10		
200			17.22 *4*
400	17.35 *4*		17.35 *4*
200			17.57 *4*
600	17.69 *5*		
55 *10*	17.71 *1*		17.71 *1*
22 *4*	18.06* *1*		
50			18.08 *2*
27 *7*	18.36		

*σ(E,θ) shows l_d = 3,4; Γ_d ~0.2 kev
d,$\alpha_o(\theta)$, d,$t_o(\theta)$ show forward peaking for all E_d
J. B. Marion, G. Weber, Phys. Rev. 102, 1355 (1956)

Levels	C^{13}(d,n)	E_d = 0.4 to 4.2; VdG	
	17.80 *5*	Γ ~0.6	thresh n,
	18.27 *3*	~0.4	~0°
	19.15 *3*	~0.15	

J. B. Marion, T. W. Bonner, C. P. Cook, Phys. Rev. 100, 847 (1955).

$N^{16}_{7\ 9}$
7^8

$\gamma(O^{16})$		$O^{(16)}$(fast n,p)	
3†	1.7	2300† (6.13)	scin,
1†	1.9	(7.12)	scin γγ
30†	2.7		

Continued

$N^{16}_{7\ 9}$ 7^{s}

Continued

(1.7, 1.9 γ)(E_γ > 6.4) No (2.7 γ)(E_γ > 6.4)
(2.7γ)(E_γ > 3.5)(θ) contains significant terms in $\cos^4\theta$; $\eta(\pi) \sim +0.7$. See also O^{16}.
1% β branch to 8.87 level implied; logft = 4.4

D.H. Wilkinson, B.J. Toppel, D.E. Alburger, Phys. Rev. 101, 673 (1956).

$\gamma(O^{16})$	6.1	O^{18}(1.3-Mev d, α)
	7.1	scin

No 1.0 γ
$\sigma[O^{18}(d,\alpha)]/\sigma[C^{14}(d,\gamma)]$ > 400 at E_d = 1.3 for 7^{s}N

N.A. Bostrom, E.L. Hudspeth, I.L. Morgan, Bull. Am. Phys. Soc. 1, No. 2, 94, M12 (1956); verbal report.

$\gamma(O^{16})$		$F^{19}(n,\alpha)$; $O^{(16)}(n,p)$
145†	(6.130)	scin pr
10†	7.116 *20*	

Both γ's decay with same τ (7^{s} ± 7%)
No evidence for an isomeric level of N^{16}

B.J. Toppel, Phys. Rev. 103, 141 (1956).

$\gamma(O^{16})$ N^{15}(3.3-Mev d, p)
6.13 and 7.12 γ's decay with same τ (7^{s} ± 10%)

$\gamma(N^{16})$	$N^{15}(d,p\gamma)$			E_d = 3.3
100†	0.1204 *10*	100†	0.276 *2*	pc,
5†	0.160 ?	10†	0.400 *5*	scin

No (0.120γ)γ

R.C. Hanna, J.M. Freeman, J.O. Newton, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Levels	$O^{18}(d,\alpha)$	E_d = 0.850; sd,
	g.s. Q = 4.237 *9*	4 angles
	0.116 *6*	
	0.300 *12*	
	0.391 *12*	

No α's to levels from 0.391 to 1.24 (<15% of g.s. group at 135°)

R.T. Pauli, Arkiv Fysik 9, 571 (1955).

Levels	$C^{14}(d,p)2.4^{s}C^{15}$	E_d = 1.3 to 3.0
12.26	$\Gamma > 0.1$	
12.86	$\Gamma > 0.1$	

R.A. Douglas, B. Gasten, J. Downey, A. Mukerji, Bull. Am. Phys. Soc. 1, No. 1, 21, DA13 (1956).

$O^{14}_{8\ 6}$ 72^{s}

β^+	(4.1)	sl

4.1β^+/1.84β^+ = 0.60 ± 0.10%

R. Sherr, J.B. Gerhart, H. Horie, W.F. Hornyak, Phys. Rev. 100, 945 (1955).

$O^{15}_{8\ 7}$

Level	$N^{(14)}(d,n)$	E_d = 1.85; d, n(θ)
g.s.	Q = 5.21 *7*	l_p = 1

I. Nonaka, S. Morita, N. Kawai, T. Ishimatsu, S. Suematsu, K. Takeshita, Y. Nakajima, Y. Wakuda, J. Phys. Soc. Japan 11, 1 (1956).

$O^{15}_{8\ 7}$

Levels	$N^{(14)}(d,n)$	E_d = 1.0 to 4.5; VdG
1+	6.20 *3*	thresh n, ~0°
4.6+	6.841 *9*	
0.9+	6.909 *9*	

Graph of σ(~0°) given for n yield
+Relative slow-n intensities at thresholds

J.B. Marion, R.M. Brugger, T.W. Bonner, Phys. Rev. 100, 46 (1955).

Level	$O^{(16)}(\gamma,n\gamma)$	$E_\gamma \geq$ 21
γ	(6.14)	scin

No other γ (< 20% of 6.14γ) See also N^{15}

N. Svantesson, Bull. Am. Phys. Soc. 1, No. 1, 28, GA3 (1956); verbal report.

Levels	$N^{(14)}(p,p)$	E_p = 0.85 to 1.90
Level	J	sπ152°
8.340	$1/2^+$	σ
8.798	$1/2^+$	
8.971	$3/2^-, 5/2^-$?	
9.030	$3/2^-, 5/2^-$?	

G.W. Tautfest, S. Rubin, Phys. Rev. 103, 196 (1956); Phys. Rev. 98, 280A (1955).

Level	$N^{14}(p,p)$	E_p = 0.95 to 3.96
10.33 *8*		pc, 132°

S. Bashkin, R.R. Carlson, J.A. Jacobs, Bull. Am. Phys. Soc. 1, No. 4, 212 SA9 (1956).

Levels	$C^{(12)}(He^3,p)$	E_{He^3} = 1.0 to 2.5
13.06	He^3,p(θ) varies rapidly	
13.52	with E_{He^3} for all	
13.96	p groups	

$C^{(12)}(He^3,n)$
σ(n)/σ(p) rises, then levels off
He^3,p(θ) and He^3,n(θ) similar

D.A. Bromley, H.E. Gove, A.E. Litherland, E.B. Paul, E. Almqvist, Bull. Am. Phys. Soc. 1, No. 4, 195 N2 (1956); verbal report.

$O^{16}_{8\ 8}$

Level	$O^{(16)}(n,n'\gamma)$	E_n = 7.06; scin
γ	6.09 *6*	$\sigma(95°)$ = 8.3 *2* mb/sterad

R.B. Day, Phys. Rev. 102, 767 (1956).

Levels	$O^{(16)}(p,p')$	E_p = 19, 10 angles	
$\int d\sigma$ in mb	Level	Coincidences	J
59	6.14 *2*		
34	7.02 *2*		
28	8.87 *3*	p'(~2.4°, ~6, ~7γ)	2^- ($3^\pm$?)
8	9.85 *3*	*2.78 *4* in singles	
8	10.34 *3*		
19	11.08 *3*	p'(~6, ~7γ)	2^- (3^+?)
11	11.51 *3*		
6	12.02 *3*	p'γ	
11	12.53 *3*	p' (4.4γ in C^{12}?)	
~10	13.06 *3*		
	13.39		scin p

p,p'(θ) given for all but last two groups

W.F. Hornyak, R. Sherr, Phys. Rev. 100, 1409 (1955); 99, 632A (1955).

$O^{16}_{8\ 8}$ Level $F^{19}(p,\alpha)$ $E_p = 1.38$

(6.91) $\tau \leq 1.7 \times 10^{-14}$s

From new Doppler shift measurements giving range-velocity curve for O^{16} in Cu backing

S.Devons, G.Manning, J.H.Towle, Proc. Phys. Soc. 69A, 173 (1956).

Levels $O^{(16)}(\gamma,\gamma)$ γ's from $F^{19}(p,\alpha\gamma)$

(6.91) $\tau = 2.3^{+2.9}_{-0.9} \times 10^{-14}$s scin

(7.12) $\tau = 7^{+12}_{-3} \times 10^{-15}$s

C.P.Swann, F.R.Metzger, Bull. Am. Phys. Soc. 1, No. 4, 211 SA6 (1956); verbal report.

Level $F^{19}(p,\alpha\gamma)$ $E_p = 1.3$ to 4.1

8.87 2 level $J = 2^{-*}$ scin pr,

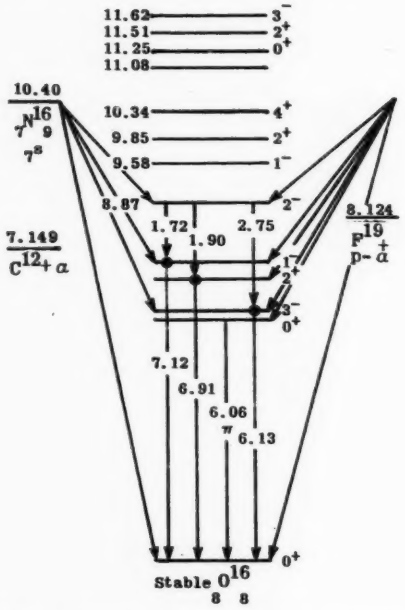
γ	3†	1.72 3	(6.13)	scin $\gamma\gamma$,
	1†	1.90 3	(6.91)	scin
	24†	2.75 2	(7.12)	

(2.75 γ)(6.13 γ) No (2.75 γ)(6.91, 7.12 γ)

(1.72, 1.90 γ)($E_\gamma > 6.3$) No 8.87γ (<3.8†)

*From γ intensities and (2.75 γ)(6.13 γ)(θ)

This level is not predicted by α-particle model



D.H.Wilkinson, B.J.Toppel, D.E.Alburger, Phys. Rev. 101, 673 (1956), 99, 632A (1955).

Levels $N^{15}(p,\alpha\gamma)$ $E_p = 0.80$ to 3.80

Level	Γ(kev)	scin 4.43 γ, p,$\gamma(\theta)$
12.95		
13.09	125 15	
13.25		
13.67	65 10	
13.98 2	25 5	J
14.92 3	45 10	4^+
15.20 4	75 15	$2^-,3^+$
15.25 5	700	
15.41 4	100 25	2^+ probable

Continued

$O^{16}_{8\ 8}$

Continued

$N^{15}(p,\gamma)$ reaction shows 13.09 level only

R.R.Carlson, S.Bashkin, Bull. Am. Phys. Soc. 1, No. 4, 211 SA7 (1956); verbal report.

Levels $N^{15}(p,\alpha_o)$ $E_p = 0.95$ to 3.80

	13.09	pc, 132°
	13.25	
50†	14.91 2	
~50†	15.25 broad	
100†	15.39 3	

13.67, 13.98, 15.20 levels not observed

†Total σ in mb

J.A.Jacobs, S.Bashkin, R.R.Carlson, Bull. Am. Phys. Soc. 1, No. 4, 212 SA8 (1956); verbal report.

Levels $N^{15}(p,\alpha_1\gamma)$ $E_p = 0.8$ to 3.2

	Level	Γ(kev)	scin γ
0.8†	13.235	22.5	
1†	13.666	95 ± 10	
~0.1†	13.976	<30	
1.1†	14.922	90 ± 20	

No level at 14.2

†Relative yield of C^{12} 4.4γ

R.R.Carlson, S.Bashkin, Phys. Rev. 100, 1254A (1955); verbal report.

Levels $N^{15}(p,\alpha\gamma)$ $E_p = 2.65$ to 5.25

Level	Γ(kev)	scin 4.43γ
14.92	60	
15.19	60	
15.40	95	
15.79	30	
16.43	25	

L.Lidofsky, K.Jones, R.Bent, J.Weil, T.Kruse, M.Bardon, W.W.Havens,Jr., Bull. Am. Phys. Soc. 1, No. 4, 212 SA10 (1956).

Levels* $O^{(16)}(\gamma,n)2.0^{m}O^{15}$ $E_\gamma \leq 23.2$

$\int\sigma dE$	Level	$\int\sigma dE$	Level	$\int\sigma dE$	Level
0.0046	15.85	0.182	17.68	0.617	20.79
0.040	16.03	0.254	17.84	0.857	20.93
0.027	16.47	0.059	18.04	1.36	21.21
0.041	16.75	0.094	18.70	0.853	21.52
0.084	16.95	0.130	19.01	2.21	22.37
0.111	17.02	0.396	19.18	3.14	22.54
0.262	17.13	0.495	20.33	3.47	22.76
0.404	17.18	0.603	20.58	3.06	23.02
0.202	17.55				

Estimates of Γ_γ show levels $\leq$ 19.2 are E2 excited, 22 to 23 are E1 excited

*Sharp breaks in activation curve

A.S.Penfold, B.M.Spicer, Phys. Rev. 100, 1377 (1955).

$O^{(16)}(\gamma,n)$ $E_\gamma = 17.6$ to 17.9

No resonance observed O in liquid scin

J.G.Campbell, Australian J. Phys. 8, 449 (1955); Phys. Rev. 95, 1357 (1954).

$O^{16}_{8\ 8}$ $O^{(16)}(\gamma,4\alpha)$ $E_\gamma \leq 70$, ppl

Levels in O^{16}, C^{12}, Be^8 connected by α emission

E_γ	O^{16}	C^{12}	Be^8
<25	22.3	9.6 ?	g.s., not 2.9
		10.8	g.s., not 2.9
		12.3 ? *3*	not g.s.
25 to 28	26	15 to 16	?, not 4.1
	27.5		
28 to 35	29.5	16	2.9
	32.5	18 to 19	
	35		323 stars

W.K.Dawson, D.Livesey, Can. J. Phys. 34, 241 (1956).

Level $C^{(12)}(\alpha,\alpha_0 \text{ or } \alpha_1)$

23.54 *10* $E_\alpha = 20.4$ to 22.6; s

$\alpha,\alpha_i(\theta)$ not symmetric about 90° c.m.

V.K.Rasmussen, D.W.Miller, M.B.Sampson, Phys. Rev. 100, 181 (1955).

$N^{(14)}(d,p+7.31\gamma)$ $E_d = 2.4, 4.0, 5.3$

$N^{(14)}(d,n+6.82\gamma)$ sl pr

$\sigma(d,p\gamma)/\sigma(d,n\gamma) = 2.6,\ 1.5,\ 0.9$ for above E_d

R.D.Bent, T.W.Bonner, J.H.McCrary, W.A. Ranken, Phys. Rev. 100, 771 (1955).

$O^{17}_{8\ 9}$ Level $O^{(16)}(d,p)$ $E_d = 0.483$ to 0.677

g.s. $\sigma(E_d = 0.677) = 14.4$ mb ppl

Values given of $a_1 \cdots a_4$ in $\Sigma a_i P_i(\theta)$ for $d,p(\theta)$

Some stripping indicated

$\int \sigma d\theta$ increases with E_d from 0.9 to 14.4 mb, values differ from those of Valckx* obtained with scin

B.Koudijs, Thesis, University of Utrecht (1956); *P.P.G.Valckx, Thesis, University of Utrecht (1956).

Level $O^{(16)}(d,p)$ $E_d = 0.76$ to 1.40

(0.872) ppl

Values given of $a_0 \cdots a_5$ in $\Sigma a_i P_i(\theta)$ for $d,p(\theta)$

Legendre coefficients vary greatly with E_d

M.K.Jurić, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 41 (1956).

Levels $O^{(16)}(d,p)$ $E_d = 1.05$ to 2.51

g.s. scin, 5° to 160°

(0.872)

$d,p(\theta)$ of stripping type except near resonance ($E_d = 1.7$) where curves are flattened

J.C.Grosskreutz, Phys. Rev. 101, 706 (1956).

Levels $O^{(16)}(d,p)$ $E_d = 1.43$ to 1.90

(g.s.) ppl

(0.872)

Graphs of $d,p(\theta)$ given

F.Alba, T.A.Brody, A.Fernández, M.Mazari, V. Serment, M.Vasquez, Anales Inst. Fisica Mexico, 1, 1 (1955); Rev. Mexicana Fiz. 4, 207 (1955).

$O^{17}_{8\ 9}$ Levels $O^{(16)}(d,p)$ $E_d = 8.9$

g.s. $l_n = 2$ $d,p(\theta)$

(0.872) $l_n = 0$

F.A.El Bedewi, Proc. Phys. Soc. 69A, 221 (1956).

Levels $O^{(16)}(d,p)$ $E_d = 9$

Level	l_n	s; $d,p(\theta)$
g.s.	2	
(0.875)	0	
(3.055)	$d,p(\theta)$	isotropic
(3.840)	3	
(4.56)	1	
(5.08)	2	
5.23		

T.S.Green, R.Middleton, Proc. Phys. Soc. 69A, 28 (1956).

Levels $C^{(13)}(\alpha,n)$ $E_\alpha = 0.83$ to 3.52

J	Level	Γ(kev)	J	Level	Γ(kev)
5/2	7.162	<8		8.341	20
5/2?	7.375	<5	5/2	8.400	<15
	7.570	<15	1/2	8.467	20
	7.679	30		8.498	<15
	7.93	150	1/2	8.70	90
	8.06	80		8.89	130
	8.21	75	5/2	8.96	70

$\alpha,n(\theta)$

R.B.Walton, J.D.Clement, Bull. Am. Phys. Soc. 1, No. 4, 211 SA5 (1956); verbal report.

Levels $C^{13}(\alpha,n)$ $E_\alpha = 2.0$ to 5.2

σ*	Level	Γ(kev)	σ*	Level	Γ(kev)
2.7	7.94	100	17	8.95	30
6.7	8.06	100	3.5	9.15	≤8
14	8.20	80	≥17	9.2	≤5
≥12	8.335	≤6	7.4	9.50	15
24	8.40	10	28	9.725	25
10	8.465	10	6	9.78	70
≥36	8.50	≤7	38	9.885	15
9.1	8.70	90	6.8	9.97	200
20	8.89	150	30	10.20	65

*mb/sterad, 0° to 20°

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

Levels $C^{13}(\alpha,n)$ $\alpha,n(\theta)$

J	Level	J	Level
3/2	(8.19)	7/2	(9.50)
5/2	(8.40)	7/2	(9.72)
3/2(5/2?)	(8.50)	9/2	(9.88)
3/2(−?)	(8.70)	7/2	(9.97)
3/2	(8.89)		long counter

J.P.Schiffer, A.A.Kraus, Jr., J.R.Risser, Bull. Am. Phys. Soc. 1, No. 4, 211 SA3 (1956); verbal report.

O^{17} 8 9

Levels $C^{13}(\alpha,n)$ $E_\alpha = 1.5$ to 3.7; 0°
$O^{(16)}(n)$ $E_n = 4.4$ to 5.5

J	Level	J	Level	Γ_n/Γ_α
	8.06	≥ 3/2	8.51	
	8.21	3/2	8.71	~20
	8.35		8.91	
≥3/2	8.41		8.97	
	8.47		9.20	

Spins from $\sigma(0°)$ at resonance

R.L.Becker, H.H.Barschall, Phys. Rev. 102, 1384 (1956).

O^{18} 8 10

Level $O^{18}(p,p')$ $E_p = 4.58, 5.28$
1.981 4 sπ
2.445 level not observed

R.R.Spencer, G.C.Phillips, J.P.Schiffer, T.E. Young, Bull. Am. Phys. Soc. 1, No. 2, 95, M13 (1956).

Levels $F^{19}(n,d)$ $E_n = 14.1$
st g.s. Q = -5.79 8 pc
$l_p = 0$ n,d(θ)
w 1.9 $l_p = 2(1?)$
No other levels below 3.0

F.L.Ribe, Phys. Rev. 100, 1254A (1955).

Levels $O^{17}(d,p)$ $E_d = 7.68, 7.83$
$O^{18}(d,d')$ 5 angles 28° to 90°
(1.986) sd
3.555 13
Levels predicted between 1.99 and 3.55 were not observed

D.R.Bach, P.V.C.Hough, Phys. Rev. 102, 1341 (1956).

Levels $F^{19}(t,\alpha)$ $E_t = 1.8$
1.989 24 sd; 90°
3.504 34 5.311 40
3.929 40 5.456 40
5.007 40 6.190 40
5.170 40 6.328 40

N.Jarmie, Bull. Am. Phys. Soc. 1, No. 1, 28, GA4 (1956); verbal report.

O^{19} 8 11

Levels $O^{18}(d,p)$ $E_d = 0.800$
g.s. sd
(0.096)
Values given of a_i in $\Sigma a_i P_i(\theta)$ for d,p(θ)

K.Ahnlund, Arkiv Fysik 10, 425 (1956).

F^{16} 9 7

$N^{(14)}(He^3,n)$ $E_{He^3} \leq 2.0$
Reaction not observed, g.s. Q<−1.65

J.W.Butler, Bull. Am. Phys. Soc. 1, No. 2, 94, M8 (1956).

F^{17} 9 8

Levels $O^{(16)}(d,n)$ $E_d = 1.8$ to 4.3; VdG
g.s. Q = -1.626 4 thresh n,
0.499 3 ~0°
Graph of $\sigma(\sim 0°)$ given for n yield

J.B.Marion, R.M.Brugger, T.W.Bonner, Phys. Rev. 100, 46 (1955).

Levels $N^{(14)}(\alpha,n)$ $E_\alpha = 8.16$
g.s. Q = −4.76 7 a p-recoil,
0.53 4 thresh n, ~0°

W.T.Doyle, A.B.Robbins, Phys. Rev. 101, 1056 (1956); 98, 1185A (1955).

Levels $O^{(16)}(p,p)$ $E_p = 2.5$ to 5.6
3.10 J = 1/2−* 5.45 Γ ~0.60
3.86 5.66 ~0.50
~4.7 Γ~1.0 5.83 ~0.60
*From $\sigma(90°)$ as $f(E_p)$

R.R.Henry, G.C.Phillips, C.W.Reich, J.L. Russell, Bull. Am. Phys. Soc. 1, No. 2, 96, N6 (1956).

F^{18} 9 9

Level $F^{19}(p,d)$ $E_p = 18.9$
8.5† g.s. Q = −8.12 20
†σ(11°) in mb/sterad $l_n = 0$ p,d(θ)

J.B.Reynolds, K.G.Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

Levels $O^{(16)}(He^3,p\gamma)$ $E_{He^3} = 2.0$
γ 0.94* scin
1.06* 2.10
1.69 2.49
*$O^{18}(p,n\gamma)$ thresholds confirm these levels

J.W.Butler, H.D.Holmgren, W.E.Kunz, Bull. Am. Phys. Soc. 1, No. 1, 29, GA5 (1956); verbal report.

Levels $O^{18}(p,n\gamma)$ $E_p = 2.5$ to 4.2
0.950 15 $\tau > 0.1^{\mu\mu}s$ { thresh n
1.050 20 $\tau < 0.1^{\mu\mu}s$ { scin
Doppler shift observed for 1.05γ, not for 0.95γ

V.Naggiar, M.Roclawski-Conjeaud, D. Szteinsznaider, M.Thirion, J. phys. radium 17, 561 (1956); Compt. rend. 242, 1443 (1956).

Level $O^{(16)}(d,p)$ $E_d = 0.4$ to 0.7
8.11 scin, 0°, 120°

F.P.G.Valckx, Thesis, University of Utrecht (1956).

Levels $O^{(16)}(d,p_1)$ $E_d = 1.7$ to 4.6
9.18 pc 10°
9.35 10.52
9.43 10.74
9.80 10.86
9.95 11.04
10.13 11.17
10.34 11.4

M.Roclawski-Conjeaud, E.Cotton, Nuclear Phys. 1, 603 (1956).

$F^{18}_{9\ 9}$ Levels $O^{(16)}(d,n)$ $E_d = 1.8$ to 4.3; VdG

9.5		**10.4**	thresh n,
9.6		**10.6**	~0°
9.7	$J = 2^+, 3^{+*}$	**10.8**	
10.1		**11.0**	
10.3		**11.2**	

*Increase of fast n's implies s wave to g.s.

J.B.Marion, R.M.Brugger, T.W.Bonner, Phys. Rev. 100, 46 (1955).

Level $O^{(16)}(d,\alpha)$ N^{14} 2.31 level
~**14.5** from resonance at E_d ~7

C.P.Browne, Phys. Rev. 100, 1253A (1955); verbal report.

$F^{19}_{9\ 10}$ Levels $F^{19}(p,p'\gamma)$ $E_p = 0.873$, 0.935

γ (**0.109**) $\alpha_K = 0.00210$ *45* E1 sl,
(**0.197**) $\alpha_K = 0.00191$ *60* E2 scin
Used K/L = 8; corrected for anisotropy

W.R.Mills, Jr., H.H.Hilton, III, C.A.Barnes, Phys. Rev. 100, 1794A (1955).

$F^{19}(p,p'\gamma)$ CaF_2 on Cu foil
μ(0.197 level) = + **3.0** *7* $\gamma\gamma(\theta,H)$

K.Sugimoto, A.Mizobuchi, Phys. Rev. 103, 739 (1956).

$F^{19}(n,p)O^{19} \rightarrow F^{19}$ HF solution
μ(0.197 level) = + **3.50** *24* $\gamma\gamma(\theta,H)$

W.R.Phillips, G.A.Jones, Phil. Mag. 1, 576 (1956).

$F^{19}(p,p'\gamma)$ KF solution
μ(0.197 level) = + **3.70** *45* $p,\gamma(\theta,H)$

P.Lehmann, A.Lévêque, M.Fiehrer, R.Pick, J. phys. radium 17, 560 (1956); Compt. rend. 241, 700 (1955). Phys. Rev. 104, 411 (1956).

$F^{19}(p,p'\gamma)$ $\gamma\gamma(\theta,H)$
μ(0.197 level) = + **3.4** *9*
Gyromagnetic ratios of 1.35 and -1.90 fit data

P.B.Tracey, Nature 176, 923 (1955).

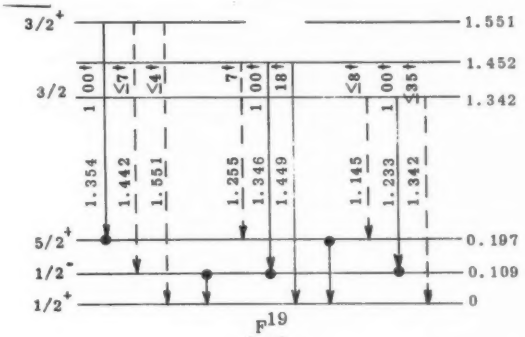
γ $F^{19}(p,p'\gamma)$ $E_p = 2.4$ to 4.1

(**0.110**)	scin $\gamma\gamma$, scin pr
(**0.197**)	**1.346** *10*
1.233 *10*	**1.354** *10*
1.255 ?	**1.449** *10*

(0.110γ)(1.233, 1.346γ) No (0.110γ, (1.449γ)
(0.197$\gamma\gamma$)(1.354γ) delay observed
p(~1.24γ)(θ) $\eta(0) = +0.3$
p(~1.35γ)(θ) $\eta(0) = -0.3$
No 1.145γ, 1.442γ, 1.551γ

Continued

$F^{19}_{9\ 10}$ Continued



$F^{19}_{9\ 10}$

†Relative number of transitions from level

B.J.Toppel, D.H.Wilkinson, D.E.Alburger, Phys. Rev. 101, 1485 ; 100, 1254A (1956).

γ $F^{19}(n,n'\gamma)$ $E_n = 0.2$ to 1.8

(**0.110**)	scin γ
(**0.197**)	
1.37	Threshold at 1.55 *2*

All γ's show broad resonance at $E_n = 1.6$

J.J.Van Loef, D.A.Lind, Phys. Rev. 101, 103 (1956); 98, 224A (1955).

$F^{19}(n,p)O^{19} \rightarrow F^{19}$
(1.35 γ)(0.197γ)(θ) implies J = 3/2, 5/2, 1/2

W.R.Phillips, G.A.Jones, Phil. Mag. 1, 576 (1956).

$F^{19}(n,p)O^{19} \rightarrow F^{19}$
(1.35 γ)(0.197γ) delay = 87$^{m\mu s}$ *2* (half-life)

C.M.P.Johnson, Phil. Mag. 1, 573 (1956).

$F^{19}(p,p'\gamma)$ $E_p = 4.3$
(1.35 γ)(0.197γ) delay = 85$^{m\mu s}$ *5* (half-life)

M.Fiehrer, P.Lehmann, A.Lévêque, R.Pick, Compt. rend. 241, 1746 (1955); Phys. Rev. 104, 411 (1956).

γ $F^{19}(n,n'\gamma)$ $E_n = 0.54$ to 3.7

(**0.110**)	
(**0.197**)	**1.360** *12*
1.236 *12*	**1.472** *16*
1.356 *12*	**2.59*** *4*

(0.110γ)(1.236, 1.356γ) (0.197γ)(1.360γ)
*Threshold at ~3.7

J.M.Freeman, Phil. Mag. 1, 591 (1956).

γ $F^{19}(n,n'\gamma)$ $E_n = 2.56$; scin

$\sigma(95°)$	E_γ	$\sigma(95°)$	E_γ
15 *3*	**0.110** *1*	24 *3*	**1.358** *10*
43 *6*	**0.197** *2*	5 *1*	**1.46** *3*
4 *1*	**1.234** *20*	2 *1*	**1.56** *3*

R.B.Day, Phys. Rev. 102, 767 (1956).

F^{19}
9 10

Levels $F^{19}(n,n')$ $E_n = 2.45$ pulsed n's

$\sigma(90^\circ)$	Level
23 *3*	1.46 *3*
23 *3*	1.55 *3*

σ units: mb/sterad

L. Cranberg, J.S. Levin, Phys. Rev. 103, 343 (1956).

Levels $F^{19}(d,d')$ $E_d = 8.9$

1.60 *2* $l_d = 2$
2.83 *2*

s

P.A. El Bedewi, Proc. Phys. Soc. 69A, 221 (1956).

Levels $O^{18}(d,n)$ $E_d = 0.4$ to 4.5

6.184* *18*
8.48* *2*

*$l_n = 0$ from rate of rise of slow n yield

M.V. Harlow, J.B. Marion, R.A. Chapman, T.W. Bonner, Phys. Rev. 101, 214 (1956).

Level $O^{18}(p,\gamma)$ $E_r = 1.169$

9.068 J = 1/2

p(6.3 γ)(θ) $\eta(0) = -0.15$

J. Butler, H.D. Holmgren, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Levels $O^{18}(p,n)$ $E_p = 2.5$ to 3.8 pc

	Level	Γ(kev)	J	p,n(θ)
40†	10.471 *2*	40		
11†	10.542 *6*			
16†	10.586 *2*	35		
81†	10.839 *2*	60		
42†	10.957 *2*	45	3/2	
100†	11.050 *2*	65	1/2?	
93†	11.162 *2*	45	3/2	
58†	11.265 *4*		1/2?	
97†	11.365 *20*	85		
97†	11.511 *20*			

H. Mark, C. Goodman, Phys. Rev. 101, 768 (1956).

Levels $O^{18}(p,n)$ $E_p = 2.5$ to 4.3 BF_3

10.480	11.170	
10.548	11.283	
10.600	11.446	
10.846	11.527	
10.976	11.650	
11.068	11.851	

V. Naggiar, M. Roclawski-Conjeaud, D. Szteinsznaider, J. Thirion, Compt. rend. 242, 1443 (1956).

$F^{19}(\gamma,p)$ $E_\gamma \leq 16.5$; 235 tracks

For $E_p = 4.4$ to 8.5, $\sigma(\theta) \sim 1 + 15\sin^2\theta$ ppl

$E_p = 2.9$ to 4.4, $\sigma(\theta) \sim 10 + 19\sin^2\theta$

W.B. Lasich, E.G. Muirhead, G.G. Shute, Australian J. Phys. 8, 456 (1955).

F^{20}
9 11

Levels $F^{19}(d,p)$ $E_d = 0.75$ to 1.45; ppl d,p(θ)

1.0†	g.s.	no stripping
2.7†	(0.65)	$l_n = 2$
2.1†	(0.99), (1.06)	$l_n = 0$

†Relative values of $\int d\sigma$ at $E_d = 1.0$

S. Takemoto, T. Dazai, R. Chiba, S. Suganomata, S. Ito, Phys. Rev. 101, 772 (1956).

Levels $F^{19}(d,p)$ $E_d = 8.9$ d,p(θ)

$(2J+1)\theta^2$	Level	l_n	$(2J+1)\theta^2$	Level	l_n
0.00015	g.s.	0			
0.00414	g.s.	2	0.036	(4.310)	0
0.080	(0.652)	2	0.007	5.04 *2*	1
0.005	(0.828)	2	0.010	5.19 *2*	1
0.005	(0.988)	2	0.018	5.27 *2*	1
0.001	(1.059)	0		5.72 *2*	
	(1.309)	*	0.044	5.87 *2*	1
0.081	(2.048)	2	0.09	5.95 *2*	1
0.028	(2.195)	2		6.25 *2*	
0.057	(2.870)	3	0.09	6.52 *2*	1
0.006	(2.966)	1	0.05	6.63 *2*	1
0.071	(3.491)	0	0.07	6.81 *2*	1
0.071	(3.528)	0		6.98 *2*	
0.021	(4.079)	0	0.04	7.20 *2*	1

No level at ~2.5

*Isotropic

F.A. El Bedewi, Proc. Phys. Soc. 69A, 221 (1956).

Capture γ's F^{19}(th n,γ) sm pr

45†	4.07 *2*	22†	5.54 *2*	
13†	5.10 *2*	15†	6.018 *11*	
25†	5.28 *2*	29†	6.599 *11*	

†Photons/100 F captures

P.J. Campion, G.A. Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28, GA2 (1956); verbal report.

Levels $F^{19}(n,n)$ Li(p,n) n,n(θ)

E_o(kev)	Level	l_n	J
28	6.627	1	1^- or 2^-
50	6.648	1	1^-
99	6.694	1	1^-

R.C. Block, H.W. Newson, Bull. Am. Phys. Soc. 1, No. 1, 55, R3 (1956).

Levels $F^{19}(n,\alpha)7.4\,^8N^{16}$ $E_n = 3.0$ to 8.0

	9.8	90+	10.51 *5*	
50+	10.03 *5*	170+	10.61 *5*	
60+	10.11 *5*	190+	11.22 *5*	
40+	10.18 *5*	270+	12.2 *1*	

+Peak σ in mb

J.B. Marion, R.M. Brugger, Phys. Rev. 100, 69 (1955).

Levels $O^{18}(d,\alpha)$ $E_d = 0.7$ to 3.0

76†	13.59 *1*	$\Gamma \sim 0.50$
87†	13.90 *1*	~0.40

Continued

F^{20} 9 11

Continued

79†	14.25 *1*	~0.30
100†	14.94 *1*	>0.60

N.A.Bostrom, E.L.Hudspeth, I.L.Morgan, Bull. Am. Phys. Soc. 1, No. 2, 94, M12 (1956).

F^{21} 9 12

Levels $F^{19}(t,p)$ E_t = 1.8

g.s	Q = 6.199 *30*	sd; 90°
0.269		
1.087		
1.694		
2.036		

N.Jarmie bull. Am. Phys. Soc. 1, No. 1, 28, GA4 (1956); verbal report. Phys. Rev. 99, 1043 (1955).

Ne^{19} 10 9

Levels $F^{19}(p,n)$ E_p = 4.2 to 5.9; VdG

g.s.	Q = -4.022 *5*	thresh n, ~0°
0.241 *4*		
0.280 *4*		

No other level below 1.5
Graph of $\sigma(\sim 0°)$ given for n yield

J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955).

Ne^{20} 10 10

Levels $F^{19}(d,n)$ E_d = 9.06 scin n d,n(θ)

Level	l_p
g.s.	0
(1.63)	2
~7.3	0 and 2
(9.3)	1

J.M.Calvert, A.A.Jaffe, E.E.Maslin, Proc. Phys. Soc. 68A, 1017 (1955).

Level $Na^{23}(p,\alpha)$ E_p = 1.22

(1.63)	$\tau = 53 \times 10^{-14}$s *23*

From Doppler shift. Stopping power estimated.

S.Devons, G.Manning, J.H.Towle, Proc. Phys. Soc. 69A, 173 (1956).

Levels $Ne^{(20)}(p,p')$ E_p = 18 scin

1.63	7.45
4.26	7.85
4.97	9.20
5.81	10.0

p,p'(θ) studied for the above levels.

G.Schrank, G.K.O'Neill, Bull. Am. Phys. Soc. 1, No. 1, 29, GA7 (1956).

Levels $F^{19}(p,\alpha\gamma)$ p res. calibration

Level	E_o	Γ(kev)	sπ
13.1935 *3*	0.3405 *3*	3.3	2
13.6977 *4*	0.8713 *4*	4.5	2

F.Bumiller, H.H.Staub, H.E.Weaver, Helv. Phys. Acta. 29, 83 (1956); 28, 355A (1955).

Ne^{20} 10 10

Levels $F^{19}(p,\alpha\pi)$ E_p = 1.3 to 5.5

15.86	$\Gamma \sim 0.16$		s1 pr
16.06	= 0.09	16.60	Γ = 0.27
16.20	= 0.10	16.98	= 0.10

14 additional levels observed for above E_p

W.A.Ranken, J.H.McCrary, T.W.Bonner, Bull. Am. Phys. Soc. 1, No. 2, 95, N1 (1956).

Resonances $F^{19}(p,n)$ long counter, ~0°
Peaks found at E_p = 5.3, 5.4?, 5.75

J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955).

Ne^{21} 10 11

Levels $Ne^{(20)}(d,p)$ E_d = 8.6 s; d,p(θ)

	Level	l_n	
	g.s.	d,p(θ)	isotropic
128†	0.35 *10*	2	
	1.73 *10*		
68†	2.78 *5*	0	
50†	4.58 *5*	2	
98†	4.81 *5*	1	
53†	5.43 *6*	2	
49†	5.63 *6*	2	
21†	5.78 *6*	1	
	5.89 *8*		
	6.10* *8*		
46†	6.72 *6*	2	

No 3.73 level
*Isotopic assignment uncertain
† Relative values of $\int \sigma d\theta$

H.B.Burrows, T.S.Green, S.Hinds, R.Middleton, Proc. Phys. Soc. 69A, 310 (1956).

γ $Ne^{(20)}(d,p\gamma)$ E_d = 1.13 scin pγ

0.35 *3*
1.05 *3*
1.42 *3*
2.78 *3*

S.Gorodetzky, T.Muller, M.Port, Compt. rend. 242, 1281 (1956); J. phys. radium 17, 549 (1956).

Ne^{22} 10 12

Levels $O^{18}(\alpha,n)$ E_α = 1.9 to 5

σ*	Level	Γ(kev)	σ*	Level	Γ(kev)
0.3	11.47	30	16	12.63	~200
0.9	11.68	<15	13	12.86	~40
2.3	11.75	25	16	13.03	~40
2.6	11.89	<15	29	13.11	~40
5.2	12.07	~40	42	13.20	~100
9.2	12.31	~70	27	13.35	~70
*mb/sterad, 0° to 30°			31	13.60	~40

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956).

$O^{18}(\alpha,n)$ Po α's, E_α = 2.4 to 5

No resonances observed BF_3

R.R.Roy, A.Lagasse, M.L.Goes, R.Moerman, Compt. rend. 241, 1567 (1955).

Ne^{23} 10 13 40^s

β^-		3.9 3	$Na^{23}(n,p)$; scin
$\gamma(Na^{23})$		0.440 5	scin

No 1.7, 3.0 γ's (<10%, 1% of 0.440γ resp.)
$\beta\gamma/\beta$ = 1/3 from Au^{198} comparison

H. J. Gerber, M. G. Muñoz, D. Maeder, Phys. Rev. 101, 774 (1956); Helv. Phys. Acta 28, 478A (1955).

Ne^{23} 10 13

Levels $Ne^{(22)}(d,p)$ E_d = 8.6

Level	l_n	s; d,p(θ)
102† g.s.	2	
84† (0.98)	0	

† Relative values of $\int\sigma d\theta$

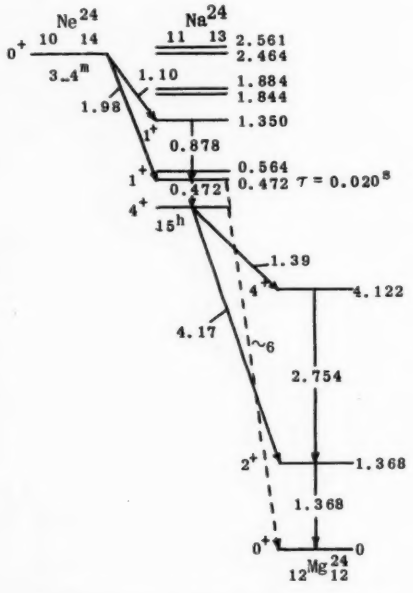
H. B. Burrows, T. S. Green, S. Hinds, R. Middleton, Proc. Phys. Soc. 69A, 310 (1956).

Ne^{24} 10 14 3.4^m

$Ne^{(22)}$(1.5-Mev t,p) chem

τ		3.38^m 2	
β^-	8%	1.10 5	scin $\beta\gamma$
	92%	1.98 5	scin
$\gamma(Na^{24})$	8†	0.878 9	scin
(1.10β)(0.878γ)			scin

p 15^h Na^{24}. Growth of 2.75γ observed
No 0.092γ, 0.564γ (<0.5†) No 0.785γ (<1†)
No γ with E_γ>1.2 (<1†). p 0.02^s Na^{24}, q.v.



B. J. Dropesky, A. W. Schardt, Phys. Rev. 102, 426 (1956); 100, 954A (1955).

Na 11 Relative isotopic abundances ms

Na^{23} 100.0%

No Na^{21} (<1 x 10^{-6}%) No Na^{22} (<3 x 10^{-6}%)

F. A. White, T. L. Collins, F. M. Rourke, Phys. Rev. 101, 1786 (1956).

Na^{21} 11 10 Levels $Ne^{(20)}(d,n)$ E_d = 1.1 to 3.0

1.46 4	thresh n, ~0°
2.426 37	

J. B. Marion, J. C. Slattery, R. A. Chapman, Phys. Rev. 103, 676 (1956).

Na^{22} 11 11 Levels $P^{19}(\alpha,n)$ E_α = 8.15

g.s. Q = -2.0 2	a p-recoil
0.45 20	thresh n, ~0°
1.15 20	2.25 20
1.8? 2	3.0 2

A. R. Quinton, W. T. Doyle, Phys. Rev. 101, 669 (1956); 97, 252A (1955).

Levels $Ne^{(20)}(d,p)$ E_d = 0.8 to 1.1

12.07	p's to Ne^{21} 0.35 level
12.13	p's to Ne^{21} 1.73 level

No resonance for p's to Ne^{21} 2.84 level a pc

S. Gorodetzky, T. Muller, M. Port, Compt. rend. 240, 1704, 2224 (1955).

Na^{22}? 11 11 $Na^{23}(\gamma,n?\gamma)$ $E_\gamma \leq 22$

No γ with $\gamma\gamma$ delay $\geq 10^{\mu s}$ scin

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).

Na^{23} 11 12 Level $Na^{23}(p,p')$ E_p = 4.4 to 4.7

0.437 5 sπ

J. P. Schiffer, C. R. Gossett, G. C. Phillips, T. E. Young, Phys. Rev. 103, 134 (1956); Bull. Am. Phys. Soc. 1, No. 2, 95, N2 (1956).

Level $Na^{23}(p,p'\gamma)$ E_p = 1.288

(0.440) $J = 5/2^{+*}$ p,$\gamma(\theta)$

*From p,$\gamma(\theta)$, assuming p- and f-wave protons and channel spin 2

R. W. Krone, W. G. Read, Bull. Am. Phys. Soc. 1, No. 4, 212 SA11 (1956).

Level $Na^{23}(p,p'\gamma)$

(0.440) $\tau < 14^{\mu\mu s}$ recoil

C. P. Swann, W. C. Porter, Bull. Am. Phys. Soc. 1, No. 1, 29, GA11 (1956); verbal report.

Level $Na^{23}(n,n')$ E_n = 2.45

$\sigma(90°)$	Level	
50 10	0.46 5	pulsed n's; σ units: mb/sterad

L. Cranberg, J. S. Levin, Phys. Rev. 103, 343 (1956).

Na^{23} 11 12

Levels $Ne^{(22)}(d,n)$ $E_d = 1.1$ to 3.0

8.435 *21*	thresh n, ~0°
9.012 *24*	

Low intensities suggest assignment to Na^{23}

J.B.Marion, J.C.Slattery, R.A.Chapman, Phys. Rev. 103, 676 (1956).

γ $Na^{23}(n,n'\gamma)$ $E_n = 0.8, 5.1$

0.15 *2*	scin γ
0.44* *2*	**1.63** *2*
0.61 *2*	**2.07** *2*

*$\sigma(E_n = 0.8, 100°) = 0.087$ *12* b/sterad

I.L.Morgan, Phys. Rev. 103, 1031 (1956); Bull. Am. Phys. Soc. 1, No. 2, 96 N11 (1956); priv. comm.

γ $Na^{23}(n,n'\gamma)$ $E_n = 2.5$; scin

0.45 *1*
1.69 *3*

E.A.Wolf, Phil. Mag. 1, 102 (1956).

Na^{24} 11 13 15^h g.s.

β^- **1.400** s$\pi\beta,\beta\gamma$

F-K linear ($E_\beta > 0.450$)

E.F.De Haan, G.J.Sizoo, Physica 21, 818 (1955).

$\gamma(Mg^{24})$ **(1.38)** **4.01** scin

(2.75) **5.3**

F.M.Tomnovec, C.S.Cook, Phys. Rev. 100, 1254A (1955); verbal report.

$\gamma(Mg^{24})$

100†	**(1.38)**	sπ Cp
102†	**(2.75)**	

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956).

$\beta(1.38\gamma)$ delay = $25^{\mu\mu s}$ *17* scin

C.F.Coleman, Phil. Mag. 46, 1135 (1955).

Na^{24} 11 13 0.02^s

τ $0.020^{s\ +30\ -15}$ $3.4^m Ne^{24}$ source

β^- ~6 scin

$\gamma(Na^{24})$ **0.472** *5* scin

d 3.4^mNe. Separated by electric field

Observation of expected 4.6 β^- prevented by presence of Ne^{23}

B.J.Dropesky, A.W.Schardt, Phys. Rev. 102, 426 (1956); 100, 954A (1955).

Na^{24} 11 13

Capture γ's Na^{23}(th n,γ) scin Cp

60†	**0.48** *2*	5†	**1.66** *5*
34†	**0.86** *2*	12†	**2.02** *3*
6†	**1.35** *3*	19†	**2.53** *3*

Study covered $E_\gamma = 0.3$ to 3

†Photons/100 Na captures, (±20%) ($\sigma_a = 0.5$)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

Resonance $Na^{23}(n,n)$ Li(p,n)

peak **0.053**	J = 3⁻ or 2⁻?	n,n(θ)
	$l_n = 1$	

R.C.Block, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 55, R3 (1956).

Resonance $Na^{23}(n,n'\gamma)$ $E_n = 0.44$ to 0.80

peaks	**0.542**	scin 0.440γ
	0.602*	**0.710***
	0.633§	**0.780**§

*n, γ isotropic §n, γ anisotropic

H.Hausman, J.E.Monahan, F.P.Mooring, S.Raboy, Bull. Am. Phys. Soc. 1, No. 1, 56, R7 (1956); verbal report.

Na^{25} 11 14 62^s

$\gamma(Mg^{25})$ $Mg^{(25)}$(fast n,p)

80†	**0.37** *1*	74†	**0.975** *10*	scin
100†	**0.58** *1*		**1.35** ?	

No 0.46γ

M.E.Nahmias, T.Yuasa, J. phys. radium 17, 373 (1956).

$\gamma(Mg^{25})$ $Mg^{(25)}$(14-Mev n,p)

95†	**0.40**	100†	**0.98**	scin
98†	**0.58**	33†	**1.61**	

No β^- to 0.58 level in Mg^{25} (< 1% of β's)

H.E.Gove, A.E.Litherland, E.B.Paul, G.A. Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 29, GA8 (1956); verbal report.

Mg 12

Relative isotopic abundances ms

Mg^{24}	**78.8%** *2*
Mg^{25}	**10.15%***10*
Mg^{26}	**11.06%** *10*

No Mg^{21} ($< 8 \times 10^{-5}$%) No Mg^{22} ($< 25 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Mg^{24} 12 12

Levels Na^{23}(d,n) $E_d = 8.4$

0.04+	g.s.	ic p-recoil
0.2+	(1.368)	
0.4†	(4.122)	$l_p = 2$
2+	(4.23)	$l_p = 0$
0.32+	5.1	
0.32+	5.5	
3+	6.3	
4.3+	7.5	$l_p = 0$ and 2
4.4+	8.4	$l_p = 0$

‡Peak σ in mb/sterad

J.M.Calvert, A.A.Jaffe, A.E.Litherland, E.E. Maslin, Proc. Phys. Soc. 68A, 1008 (1955).

Mg^{24}_{12} $_{12}$

Level $Mg^{(24)}(n,n')$ $E_n = 2.45$ pulsed n's

$\sigma(90°)$	Level
31 *3*	1.38 *3*

σ units: mb/sterad

L. Cranberg, J. S. Levin, Phys. Rev. 103, 343 (1956).

Level $Mg^{(24)}(n,n'\gamma)$ $E_n = 2.56$ scin

	$\sigma(95°)$	Level
γ	49 *4*	1.368 *10*

σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

Levels $Na^{23}(p,\gamma)$ $E_p \leq 0.53$; EA

Level	E_p	Γ(kev)
1† 11.943	0.2508 *2*	0.3 *2*
110† 11.998	0.3078 *3*	0.8 *3*
2† 12.061	0.3735 *4*	2.0 *10*
4† 12.126	0.4438 *6*	0.8 *3*
65† 12.193	0.5109 *6*	0.8 *3*

†Relative γ yield

D. A. Hancock, F. Verdaguer, Proc. Phys. Soc. 68A, 1080 (1955).

Levels $Na^{23}(p,p)$ $E_p \leq 1.5, 155°$; VdG

E_o	Level	Γ(kev)	Γ_p(kev)	J
0.797	12.477			
0.815	12.484			
0.878	12.544	8	6.8	1^+
0.922	12.586			
1.022	12.682	66 or 50	66 or 50	2^-
1.177	12.831	4	2.8	1^+
1.321	12.969			3^+
1.398	13.042	1	0.7	3^+

$Na^{23}(p,\alpha)$ $E_p \leq 1.5, 155°$; VdG

1.288	12.937
1.460	13.102

N. P. Baumann, F. W. Prosser, Jr., R. W. Krone, Phys. Rev. 100, 1244A (1955); verbal report.

Capture γ $Na^{23}(p,\gamma)$ $E_p = 0.593$

12.27 level		D(γ,p) in ppl
γ (10.9)	E1	p,γ(L_1)

Result indicates even parity for Na^{23} g.s.

I. S. Hughes, D. Sinclair, Proc. Phys. Soc. 69A, 125 (1956).

Mg^{25}_{12} $_{13}$

Level $Mg^{(25)}(n,n'\gamma)$ $E_n = 2.56$ scin

	$\sigma(95°)$	Level
γ	15 *3*	1.616 *16*

σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

Levels $Mg^{25}(p,p'\gamma)$ $E_p = 1.5$ to 2.9

1.61 level		
γ	> 96%	1.61

scin

No 0.63γ, 1.03 γ (< 1%, 3% resp. of 1.61γ)

Continued

Mg^{25}_{12} $_{13}$

Continued

1.96 level			
γ	(0.40)	55%	1.38
	(0.58)	28%	1.96
	17% 0.98		

(0.58γ)(0.40, 0.98, 1.38γ)

H. E. Gove, A. E. Litherland, E. B. Paul, G. A. Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 29, GA8 (1956); verbal report.

Capture γ $Mg^{(24)}$(th n,γ) scin Cp

49† 2.80 *3*

Study covered $E_\gamma = 0.3$ to 3

†Photons/100 Mg captures, (±20%) ($\sigma_a = 0.057$)

(Max in Mg^{25}, Mg^{26}, Mg^{27} = 44, 45, 11†)

T. H. Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Capture γ's $Mg^{(24)}$(th n,γ) scin pr

5† 2.816 *16*

1† 3.408 *18*

P. J. Campion, G. A. Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28, GA2 (1956); verbal report.

Resonance $Mg^{24}(n)$ $E_n = 0.002$ to 0.35

peak 60° 0.085 J = $3/2^-$ Li(p,n)

$^*\sigma_t$(peak) $\Gamma = 0.008$

A. Taylor, H. Marshak, H. W. Newson, Bull. Am. Phys. Soc. 1, No. 1, 62 UA3 (1956); verbal report.

Resonance $Mg^{(24)}(n,n)$ Li(p,n)

peak 0.085 J = $3/2^-$ n,n(θ)

$l_n = 1$

R. C. Block, H. W. Newson, Bull. Am. Phys. Soc. 1, No. 1, 55, R3 (1956).

Mg^{26}_{12} $_{14}$

Level $Mg^{(26)}(n,n'\gamma)$ $E_n = 2.56$ scin

	$\sigma(95°)$	Level
γ	12 *2*	1.820 *18*

σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

Capture γ's $Mg^{(25)}$(th n,γ) scin Cp

13† 1.07 *5*

22† 1.87 *3*

Study covered $E_\gamma = 0.3$ to 3

†Photons/100 Mg captures, (±20%) ($\sigma_a = 0.057$)

(Max in Mg^{25}, Mg^{26}, Mg^{27} = 44, 45, 11†)

T. H. Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

$Mg^{26}_{12\ 14}$ Capture γ's* $Mg^{(25)}$(th n,γ) sπ pr

8.55 2	10.08 2
8.93 2	11.086 25

*In addition to other known γ's

P.J.Campion, G.A.Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28, GA2 (1956); verbal report.

Resonance peaks Mg^{25}(n) E_n = 0.002 to 0.35 Li(p,n)

0.020	$\Gamma \sim 0.001$
0.081	~ 0.009
0.101	~ 0.010

A.Taylor, H.Marshak, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 62, UA3 (1956); verbal report.

$Mg^{27}_{12\ 15}$ 9.5^m $\gamma(Al^{27})$ $Mg^{(26)}$(pile n,γ) chem scin

0.66†	0.175 15
70†	0.834
30†	1.015

β/γ = 1.00 5 pc β, scin γ

No (0.834 γ)(1.015 γ) scin

W.S.Lyon, N.H.Lazar, Phys. Rev. 101, 1524 (1956).

$Mg^{27}_{12\ 15}$ Levels Al^{27}(n,p) E_n = 14; ppl several angles

< 0.2†	g.s.
1†	1.0
10†	3.5
	5.7

†% of charged particles (p and d)

R.K.Haling, Bull. Am. Phys. Soc. 1, No. 1, 29, GA9 (1956); verbal report.

Resonance peak Mg^{26}(n) E_n = 0.002 to 0.35 Li(p,n)

~ 0.320

A.Taylor, H.Marshak, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 62, UA3 (1956); verbal report.

Al_{13} Relative isotopic abundances ms

Al^{27} 100.0%

No Al^{25}, Al^{26} ($< 15 \times 10^{-5}$%)

No Al^{28}, Al^{30} ($< 5 \times 10^{-5}$%)

No Al^{29} ($< 2 \times 10^{-5}$%)

P.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$Al^{25}_{13\ 12}$ 7.6^s $Mg^{(24)}$(0.26-Mev p,γ)

No 0.98γ (< 0.5%) scin $\gamma/\gamma^{\pm}$

T.Stribel, Z.Naturf. 11a, 166 (1956).

$Al^{25}_{13\ 12}$ Levels Mg^{24}(p,γ) E_p = 0.4 to 3 scin γ, $\gamma\gamma$, p,$\gamma(\theta)$

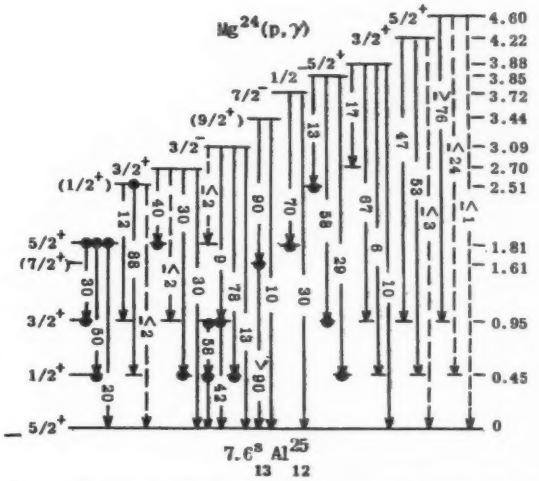
Level	J
g.s.	$5/2^+$
0.45	$1/2^+$

Continued

$Al^{25}_{13\ 12}$ Continued

Level	J
0.95	$3/2^+$
1.61	$(7/2^+)$
1.81	$5/2^+$
2.51	$(1/2^+)$
2.70	$3/2^+$
3.09	$3/2^-$
3.44	$(9/2^+)$
3.72	$7/2^-$
3.85	$1/2^-$
3.88	$5/2^+$
4.22	$3/2^+$
4.60	$5/2^+$

Levels constructed from capture γ's shown in level scheme



7.6^s $Al^{25}_{13\ 12}$

Numbers in decay lines are branching ratios of γ's

A.E.Litherland, E.B.Paul, G.A.Bartholomew, H.E. Gove, Phys. Rev. 102, 208 (1956); 99, 644A; 1649A (1955); Bull. Am. Phys. Soc. 1, No. 1, 28 GA1 (1956).

Levels Mg^{24}(p,p' + 1.37γ) E_p = 2 to 3 p,$\gamma(\theta)$ scin

Level	J
4.22	$3/2^+$
4.60	$5/2^+$
4.90	$\geq 5/2$
5.06	
5.09 ?	
5.11	$\geq 5/2$

A.E.Litherland, E.B.Paul, G.A.Bartholomew, H.E.Gove, Phys. Rev. 102, 208 (1956).

Levels $Mg^{(24)}$(p,p'γ) E_p = 1.5 to 4.2 p,$\gamma(\theta)$, p,p'(θ)

Level	J
4.22	$3/2^+$
4.60	$5/2^+$
5.09	$1/2$, $(3/2^+?)$
5.14	$5/2^+$?
5.75	$3/2^-$
6.14	$1/2$, $(3/2^+?)$

H.W.Lewis, W.T.Joyner, Bull. Am. Phys. Soc. 1, No. 6, 280 B3 (1956).

$Al^{25}_{13\ 12}$ Capture γ's $Mg^{(24)}(p,\gamma)$ scin

2.50 level $E_o = 0.222$

	0.46 5	10†	**1.54** 5
	0.95 7	100†	**2.04** 3

2.69 level $E_o = 0.418$

	0.45 5	80†	**1.33** 3
330†	**0.85**	50†	**1.80** 2
	0.88 3	110†	**2.24** 2
	0.95	100†	**2.69** 2

3.08 level $E_o = 0.825$

	0.45 4		
	0.95 3	100†	**2.62** 2
> 6†, < 20†	**2.12** 3	40†	**3.08** 3

H. Ager-Hanssen, O.M. Lönsjö, R. Nordhagen, Phys. Rev. 101, 1779 (1956).

Capture γ's $Mg^{(24)}(p,\gamma)$ $E_p \sim 0.238$; scin

2.50 level $E_o = 0.222$ $\Gamma < 2$ kev

	0.454 5	
5†	**0.97** 3	
14†	**1.56** 3	
100†	**2.05** 2	

(0.454 γ)(2.05 γ) (0.97 γ)(1.56 γ)

p(2.05 γ)(θ) isotropic

D.S. Craig, Phys. Rev. 101, 1479 (1956).

Capture γ's $Mg^{24}(p,\gamma)$ $E_p = 0.418$

2.69 level $J = 3/2^+$ scin p,$\gamma(\theta)$

(2.24)	E2/M1 = 0.004
(2.69)	E2/M1 = 0.35

J. Varma, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$Al^{26}_{13\ 13}$ $\sim 10^{6y}$ g.s. $Si^{(28)}(5\text{-Mev d},\alpha)$

β^+	1†	**1.17** 5	$\Delta J = 3$, no shape	scin
$\gamma(Mg^{26}) \sim 1$†		**1.76** 10		scin

M.J. Laubitz, Proc. Phys. Soc. 68A, 1033 (1955).

$Al^{26}_{13\ 13}$ Levels $Mg^{25}(p,\gamma)$ $E_p = 0.675$ to 0.960

Level	J	T	scin $\gamma,\gamma\gamma$, p,$\gamma(\theta)$
g.s.	5^+	0	
0.23	0^+	1	
0.42	3^+	0	
1.07		0	
1.76	2^+	0	
1.86			
2.08	2^+	0	
2.09	2^+	1	
2.32			
2.54			
3.16	$2^+,3^+$	1	
3.67			
3.76			

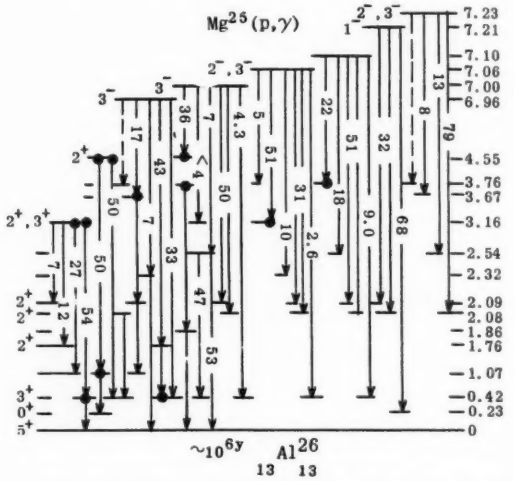
Continued

$Al^{26}_{13\ 13}$ Continued

E_o	Level	J	$(2J+1)\Gamma_\gamma$(ev)
	4.55	2^+	
0.675	**6.96**	3^-	3.5
0.720	**7.00**	3^-	2.8
0.777	**7.06**	$2^-,3^-$	1.9
0.820	**7.10**		1.2
0.940	**7.21**	1^-	1.5
0.960	**7.23**	$2^-,3^-$	3.8

Levels constructed from capture γ's shown in level scheme

2.07 and 3.27 γ's, also observed at 0.960 resonance, not fitted into level scheme



Numbers in decay lines are branching ratios of γ's

L.L. Green, J.J. Singh, J.C. Willmott, Proc. Phys. Soc. 69A, 335 (1956).

Levels $Na^{23}(\alpha,n)$ $E_\alpha = 8.16$

g.s.	Q = −**2.9** 2	a p-recoil
0.3 2*		thresh n, ~0°
1.0 2		
1.4 2	**2.5** 2	
1.8 2	**2.9** 2	

*6.7$^s\beta^+$ first appears at Q = −**3.2** 2 scin $\gamma^\pm$

W.T. Doyle, A.B. Robbins, Phys. Rev. 101, 1056 (1956).

Level $Si^{(28)}(d,\alpha)$ $E_d = 5.5$ to 7.5

0.228 5 s

Yield decreases from 62% of g.s. group at 15° to 0 beyond 60° for $E_d = 7.03$

C.P. Browne, Bull. Am. Phys. Soc. 1, No. 4, 212 SA13 (1956).

Level $Al^{27}(p,d)$ $E_p = 18$; p,d(θ)

$l_n = 2$ for group to g.s., 0.22, or 0.42 level or all three

J.B. Reynolds, K.G. Standing, Phys. Rev. 101, 158 (1956); 95, 639A (1954).

$Al^{27}_{13\ 14}$

	ground state	
J	5/2	I
$\|\mu\|$	3.6385 *3*	

L.C.Brown, D.Williams, J.Chem. Phys. 24, 751 (1956).

Levels $Mg^{24}(\alpha,p)$ $E_\alpha = 8$ pc 90°

g.s.	Q = −1.63 *7*	
0.85 *4*		2.17 *4*
1.06 *4*		2.64 *4*

H.G.Graetzer, A.B.Robbins, Bull. Am. Phys. Soc. 1, No. 6, 280 B2 (1956).

Levels $Al^{27}(p,p'\gamma)$ recoil

(0.840)
(1.010) } $\tau < 70^{\mu\mu s}$

C.P.Swann, W.C.Porter, Bull. Am. Phys. Soc. 1, No. 1, 29, GA11 (1956).

Levels $Mg^{(26)}(d,n)$ $E_d = 1.0, 6.0$ ppl; d,n(θ)

Level	l_p
1.00	2
2.31	3
2.94	1
6.75	0
8.2	1

B.Trumpy, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Level $Al^{27}(n,n')$ $E_n = 2.45$ pulsed n's

σ(90°)	Level	σ units: mb/sterad
20 *2*	1.03 *3*	

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Levels $Al^{27}(d,d')$ $E_d = 9$ s 45°

(2.23)
(2.75)
(3.04)

Graphs of d,d'(θ) given

S.Hinds, R.Middleton, Proc. Phys. Soc. 69A, 347 (1956).

Capture γ $Mg^{26}(p,\gamma)$ $E_p = 0.339$

8.59 level D(γ,p) in ppl

(7.75) E1 p,γ(1₋)

Result indicates even parity for Al^{27} 0.84 level

I.S.Hughes, D.Sinclair, Proc. Phys. Soc. 69A, 125 (1956).

γ $Al^{27}(n,n'\gamma)$ $E_n = 2.56$; scin

σ(95°)	Eγ	σ(95°)	Eγ
0.13 *3*	0.166 *3*	11 *1*	1.017 *10*
5.1 *6*	0.840 *8*	6.9 *6*	2.21 *2*

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

$Al^{27}_{13\ 14}$

γ $Al^{27}(n,n'\gamma)$ $E_n = 3.7$; scin

0.835 *10*	σ(90°) = 22 mb/sterad	
1.02 *1*	σ(90°) = 41 mb/sterad	
1.72 *2*		
1.91 *2*		
2.22 *3*		

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 100, 83 (1955).

γ $Al^{27}(n,n'\gamma)$ $E_n = 3.6$; scin

σ(100°)	Eγ	σ(100°)	Eγ
30 *6*	0.85 *2*		1.74 *2*
50 *10*	1.01 *2*	56 *11*	2.23 *2*
	1.40 *2*	σ units: mb/sterad	

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

$Al^{28}_{13\ 15}$ 2.3^m

τ 2.31^m *6* Si^{28}(12.5-Mev n,p)

A.V.Cohen, P.H.White, Nuclear Phys. 1, 73 (1956).

$Al^{28}_{13\ 15}$

Levels $Al^{27}(d,p)$ $E_d = 6, 7$; several angles, s

g.s.	Q = 5.502	
0.029	2.279	3.294
0.973	2.490	3.347
1.017	2.589	3.461
1.372	2.663	3.537
1.633	2.988	3.591
2.143	3.011	3.669
2.207	3.102	3.704

78 additional levels from 3.878 to 7.731 listed

W.W.Buechner, M.Mazari, A.Sperduto, Phys. Rev. 101, 188 (1956); 99, 644A (1955).

Levels $Al^{27}(d,p)$ $E_d = 6$; 5° to 60°

Level	l_n	Level	l_n s
g.s.	0		
0.031	0	3.347	0
1.017	2,0	3.461	1
2.143	0	3.591	1
2.663	2	3.669	0
3.294	0	3.704	0

Weak p groups corresponding to 11 levels below 3.59 approx. isotropic

H.A.Enge, W.W.Buechner, A.Sperduto, M.Mazari, Bull. Am. Phys. Soc. 1, No. 4, 212 SA12 (1956).

Levels $Mg^{25}(\alpha,p)$ $E_\alpha = 8$ pc 90°

g.s.	Q = −1.29	
1.00 *4*		
1.57 *4*		2.54 *4*
2.18 *4*		2.96 *4*

H.G.Graetzer, A.B.Robbins, Bull. Am. Phys. Soc. 1, No. 6, 280 B2 (1956).

Al^{28} 13 15

Capture γ's Al^{27}(th n,γ) scin Cp

10†	0.97 3	
14†	2.26 3	
42†	2.5 to 3.1	

†Photons/100 Al captures, (±20%) (σ_a = 0.21)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

Al^{27}(d,pγ) time of flight

p(0.032γ) delay = $1.9^{m\mu s}$ 2

J.C.Severiens, S.S.Hanna, Phys. Rev. 100, 1254A (1955); verbal report.

Resonance Al^{27}(n,n) Li(p,n)

peak 0.090 J = 3 n,n(θ)

l_n = 0 or 1 ?

R.C.Block, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 55, R3 (1956).

Al^{29} 13 16 6.6^m

γ(Si^{29}) 15† 1.28 Si^{29}(14-Mev n,p); scin

1† 2.43

No 1.15,2.03γ

D.A.Bromley, H.E.Gove, A.E.Litherland, E.B. Paul, E.Almqvist, Bull. Am. Phys. Soc. 1, No. 1, 30, GA12 (1956).

Al^{29} 13 16

Levels Mg^{26}(α,p) E_α = 8

g.s. Q = −2.90 pc 90°

1.69? 4

H.G.Graetzer, A.B.Robbins, Bull. Am. Phys. Soc. 1, No. 6, 280 B2 (1956).

Si^{28} 14 14

Levels Al^{27}(d,n) E_d = 9.02

Level	l_p	
0.18*	g.s.	2 ic p-recoil
0.49+	1.78	0
0.21+	~4.7	
2.3+	~6.4	0
0.59+	7.10	
2.4+	7.55	0
5.9+	8.18	0
15+	9.16	0
1+	10.2	0

+mb/sterad at 0° *mb/sterad at 30° peak

J.M.Calvert, A.A.Jaffe, A.E.Litherland, E.E. Maslin, Proc. Phys. Soc. 68A, 1008 (1955).

Level $Si^{(28)}$(n,n'γ) E_n = 0.35 to 3.9

γ 1.78 2 scin

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

Level Si(n,n'γ) E_n = 3.7; scin

γ 1.78 2 σ(90°) = 60 mb/sterad

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 100, 83 (1955).

Si^{28} 14 14

Level Al^{27}(p,γ) E_p = 0.99

(1.78) $\tau > 0.6^{\mu\mu s}$ (or $< 0.02^{\mu\mu s}$)

From Doppler shift. Stopping power estimated.

S.Devons, G.Manning, J.H.Towle, Proc. Phys. Soc. 69A, 173 (1956).

Level Al^{27}(p,γ) sπ,p res. calibr.

12.545 E_p = 0.9908 2

F.Bumiller, H.H.Staub, Helv. Phys. Acta 28, 355A (1955).

Capture γ Al^{27}(p,γ) E_p = 0.652

12.23 level D(γ,p) in ppl

(10.4) E1 p,γ(L)

Result indicates even parity for Al^{27} g.s.

I.S.Hughes, D.Sinclair, Proc. Phys. Soc. 69A, 125 (1956); 67A, 481 (1954).

γ Al^{27}(d,?γ) E_d = 4.6

2.8†	6.9 1$	0.6†	8.75 4	sl pr
2.4†	7.38 6*	1.0†	9.08 4	
2.3†	7.55 6*	0.7†	9.45 8	
1.9†	7.91 4	0.4†	9.87 8	
0.8†	8.28 4	0.1†	10.7 2	

†Average σ in mb for E_d = 2.7 to 4.6

May also belong to $^{\$}Mg^{25}$, Al^{28}; $^{*}Al^{28}$

R.D.Bent, T.W.Bonner, J.H.McCrary, W.A. Ranken, Phys. Rev. 100, 774 (1955).

Resonance Al^{27}(p,γ) sπ,p res. calibr.

0.9908 2

F.Bumiller, H.H.Staub, H.E.Weaver, Helv. Phys. Acta 29, 83 (1956).

Si^{29} 14 15

Levels $Si^{(28)}$(d,p) E_d = 4.44

g.s.	Q = 6.229 40	s
1.237	6.453	
2.038	6.728	
2.416	7.000	
3.083	7.577	
3.662	7.820	
4.223?	8.354	
4.931	8.832	
5.944	9.112?	
6.138?		

L.M.Khromchenko, Doklady Akad. Nauk SSSR 98, 761 (1954).

Level $Si^{(29)}$(n,n'γ) E_n = 0.35 to 3.9

γ 1.29 scin

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

$Si^{29}_{14\ 15}$

Level $Si^{29}(p,p'\gamma)$ $E_p = 2.5$ to 3.0

2.03 level $J = 5/2^+$ p,γ(θ)

γ	1†	0.75	99†	2.03	scin
	1†	1.28			

(0.75γ)(1.28γ)

D. A. Bromley, H. E. Gove, A. E. Litherland, E. B. Paul, E. Almqvist, Bull. Am. Phys. Soc. 1, No. 1, 30, GA12 (1956).

Capture γ's $Si^{(28)}$(th n,γ) scin Cp

14†	1.26 *3*	
19†	2.13 *3*	
11†	2.65 *3*	
49†	3.60 *6*	

†Photons/100 Si captures, (±20%) ($\sigma_a = 0.16$)
(Max in Si^{29}, Si^{30}, Si^{31} = 74, 13, 13†)

T. H. Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

γ P^{31}(d,?γ) $E_d = 4.6$

4.1†	4.41 *4*	2.5†	6.11 *4*		sl pr
5.0†	4.71 *4*	1.6†	6.84 *4*		
5.0†	4.94 *4*	0.7†	7.46 *8*		
3.7†	5.29 *4*	0.4†	8.16 *4*		
3.5†	5.79 *4*	0.3†	8.53 *4*		

γ's may also be assigned to P^{32} or Si^{32}
†Average σ in mb for $E_d = 2.6$ to 4.6

R. D. Bent, T. W. Bonner, J. H. McCrary, W. A. Ranken, Phys. Rev. 100, 774 (1955).

Resonance peaks $Si^{(28)}$(n,n'γ) $E_n = 0.35$ to 3.9 scin 1.78γ

1.9	
2.08	2.35
2.27	2.45

R. B. Day, A. E. Johnsrud, D. A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

Resonances $Si^{(28)}$(n,p)2.3^mAl

0.03*	5.14 ?	$E_n = 4.4$ to 8.0
0.09*	5.62 *5*	
0.28*	6.51 *5*	
0.35*	6.81 *5*	
0.37*	7.45 *10*	Γ~0.3

*Peak σ's (±50%)

J. B. Marion, R. M. Brugger, R. A. Chapman, Phys. Rev. 101, 247 (1956).

$Si^{30}_{14\ 16}$

Levels $Al^{27}(\alpha,p)$ $E_\alpha = 8$

g.s.	Q = 2.38 *3*	ppl, pc, scin
2.23 *2*		4 angles
3.52 *2*		
3.80 *4*	5.94 *4*	
4.83 *2*	6.52 *3*	
5.28 *2*	7.10 *3*	
5.52 *3*	7.38 *5*	

No 5.07, 5.62 levels

P. L. Hassler, F. E. Steigert, G. F. Pieper, Bull. Am. Phys. Soc. 1, No. 6, 280 B4 (1956).

$Si^{30}_{14\ 16}$

Level $Si^{(30)}(n,n'\gamma)$ $E_n = 0.35$ to 3.9

γ	2.19	scin

R. B. Day, A. E. Johnsrud, D. A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$P^{29}_{15\ 14}$

Levels $Si^{28}(p,p' + 1.78\gamma)$

	w	5.27		scin
64†		5.72	w	6.56
		5.95		6.82
		6.18		7.01
		6.31		7.25
	w	6.47		7.44
	w	6.52	w	7.48

†σ(0°) in mb/sterad

H. B. Willard, J. K. Bair, H. O. Cohn, J. D. Kington, Bull. Am. Phys. Soc. 1, No. 5, 264 P4 (1956); Phys. Rev. 99, 644A (1955); verbal report.

$P^{30}_{15\ 15}$ 2.5^m

τ	2.56^m *15*	P^{31}(18-Mev p,pn)
β^+	3.24 *4*	sl
No ce	No 2.32γ	sl ce, scin

D. Green, J. R. Richardson, Phys. Rev. 101, 776, (1956); 96, 858A (1954).

$P^{30}_{15\ 15}$

Levels $S^{(32)}(d,\alpha)$ $E_d = 1.6$ to 2.9

~1†	g.s.	Q = 4.831 *13*	s 63°, 90°
~1†	0.693*		
	1.44		
	1.97		

*High yield suggests T≠1

L. L. Lee, Jr., F. P. Mooring, Bull. Am. Phys. Soc. 1, No. 6, 281 B8 (1956).

Levels $Si^{29}(p,\gamma)$ scin γ,γγ

5.95 level $E_o = 0.414$ $(2J+1)\Gamma_\gamma = 0.23$ ev

γ	100†	0.69*	100†	5.33*	~1†	(5.95)

6.22 level $E_o = 0.696$ $(2J+1)\Gamma_\gamma = 0.11$ ev

γ	45†	0.70	37†	2.53		
	30†	1.25	51†	2.74	66†	4.29
	15†	1.46	56†	3.53	12†	4.80
	29†	1.97	34†	3.74	w	(6.22)

6.26 level $E_o = 0.737$ $(2J+1)\Gamma_\gamma = 0.11$ ev

γ	22.7†	0.71	0.8†	1.95		
	0.5†	1.00	8.9†	2.09	7.6†	2.91
	1.7†	1.19	2.8†	2.18	29.8†	3.39
	36.8†	1.47	17.9†	2.23	1.25†	4.18

6.44 level $E_o = 0.916$

γ	42.7†	0.7	15.1†	1.94	2.0†	4.01
	2.2†	1.02	10.3†	2.22	12.4†	4.41
	1.6†	1.22	1.2†	2.94	1.8†	5.35
	9.4†	1.48	10.0†	3.43	19.4†	5.72

Continued

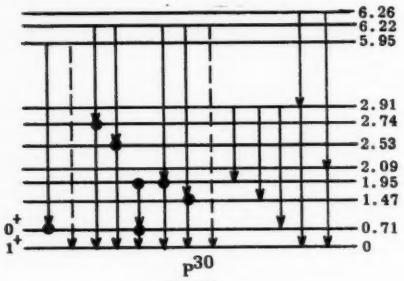
P^{30} 15 15

Continued

6.49 level $E_o = 0.970$

γ 12.8†	0.71				
3.3†	1.22	4.7†	2.50	1.2†	3.83
18.8†	1.44	3.4†	2.68	3.9†	3.94
1.5†	1.73	5.8†	2.95	6.9†	4.48
13.6†	1.97	2.3†	3.25	7.1†	4.99
5.3	2.22	12.6†	3.35	5.8†	6.42

*Isotropy of 0.69γ and strong anisotropy of 5.33γ suggest J = 0$^+$, T = 1 for 0.69 level



C. Broude, L.L. Green, J.J. Singh, J.C. Willmott, Phys. Rev. 101, 1052 (1956); priv. comm.

P^{31} 15 16

Level $P^{31}(n,n')$ E_n = 2.45 pulsed n's

$\sigma(90°)$	Level
51 7	1.25 3

σ units: mb/sterad

L. Cranberg, J.S. Levin, Phys. Rev. 103, 343 (1956).

Level $P^{31}(p,p')$ E_p = 3 to 4 sd 90°

1.264 4

No 0.4, 0.9 levels

D.M. Van Patter, C.P. Swann, W.C. Porter, C.E. Mandeville, Phys. Rev. 103, 656 (1956); Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956).

Levels $P^{31}(p,p')$ E_p = 3.0, 4.6 sd; 90°

1.264 4
2.234 8
3.133 10
3.290 10

D.M. Van Patter, C.P. Swann, M.A. Rothman, W.C. Porter, C.E. Mandeville, Amsterdam Conf. Nuclear Reactions, July 1956; Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956); verbal report; Physica 22 (1956).

Levels $Si^{30}(p,\gamma)$ E_p = 1.7 to 2.3

Level	J	
1.26	3/2$^+$	p,$\gamma\gamma(\theta)$
2.23	$\geq$5/2$^+$	

E_o			
1.73	8.96	3/2$^+$	p,$\gamma_o(\theta)$
1.82	9.05	3/2$^+$?	

E.B. Paul, G.A. Bartholomew, H.E. Gove, A.E. Litherland, Bull. Am. Phys. Soc. 1, No. 1, 39, JA2 (1956).

P^{32} 15 17 14^d

$S^{(32)}(n,p)$

β^- 1.712 4 F-K linear sl

A.V. Pohm, R.C. Waddell, E.N. Jensen, Phys. Rev. 101, 1315 (1956).

$e^+/\beta^- = 7.5\times10^{-10}$ 20 sl $\gamma^\pm\gamma^\pm$

Not corrected for external pair creation

Theoretical value* for internal pair creation is 5.5×10^{-10}

J.S. Greenberg, M. Deutsch, Phys. Rev. 102, 415 (1956); 99, 685A (1955); *K. Huang, Phys. Rev. 102, 422 (1956).

$S^{(32)}(n,p)$ chem

$e^+/\beta^- < 1.3\times10^{-5}$ cc

No new light positive particle ($< 8\times10^{-4}$%)

Spectral shape of internal bremsstrahlung agrees with theory scin

A.B. Milojević, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 21 (1956).

P^{32} 15 17

Level $S^{(32)}(n,p\gamma)$ E_n = 2.56 scin

	$\sigma(95°)$	Level
γ	1.0 2	0.077 2

σ units: mb/sterad

R.B. Day, Phys. Rev. 102, 767 (1956).

Capture γ's P^{31}(th n,γ) scin Cp

28†	0.51 2
14†	1.13 3
41†	2.19 3

Study covered E_γ = 0.3 to 3

†Photons/100 P captures, (±20%) (σ_a = 0.19)

T.H. Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

γ $P^{31}(d,?\gamma)$ E_d = 4.6

For possible γ's in P^{32} see Si^{29}, Bent et al.

S 16

Relative isotopic abundances ms

S^{32}	95.0%
S^{33}	0.760% 4
S^{34}	4.22% 1
S^{36}	0.014%

P. Bradt, P.L. Mohler, V.H. Dibeler, J. Research Nat. Bur. Standards 57, 223 (1956).

S^{32} 16 16

Levels $Cl^{(35)}(p,\alpha)$ E_p = 7.04

g.s.	Q = 1.863 8	s 90°, 130°
2.237 8		
3.780 8	4.465 10	
4.287 8	4.698 10	

P.M. Endt, C.H. Paris, A. Sperduto, W.W. Buechner, Phys. Rev. 103, 961 (1956); Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

S^{32} 16 16

Levels	$P^{31}(d,n)$		$E_d = 9.2$
1.9†	g.s.	$l_p = 0$	ic p recoil
0.35†	2.25	$l_p = 2$	
1.3†	(3.81), (4.32), (4.50)	$l_p = 0$	
0.46†	(4.74), (5.04)		
1.2†	5.83	$l_p = 2$	

†Peak σ in mb/sterad
No 0.5, 1.5 levels

J.M.Calvert, A.A.Jaffe, A.E.Litherland, E.E. Maslin, Proc. Phys. Soc. 68A, 1008 (1955).

Level	$S^{(32)}(n,n'\gamma)$		$E_n = 2.56$
	$\sigma(95°)$	Level	scin
γ	14 *1*	2.23 *2*	σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Level	$S^{(32)}(n,n'\gamma)$		$E_n = 3.7$
	$\sigma(100°)$	Level	scin
γ	36 *7*	2.20 *2*	σ units: mb/sterad

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

γ	$S^{(32)}(n,n'\gamma)$	$E_n = 3.7$; scin
	2.25 *3*	

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 100, 83 (1955).

γ	$P^{31}(d,?\gamma)$	$E_d = 4.6$

For possible γ's in S^{32} see Si^{29}, Bent et al.

Resonance peaks	$P^{31}(p,\alpha)Si^{28}$ g.s.		sd 90°
	(1.892)		
	(2.030)	~(2.827)	
	~(2.658)	~(2.860)	

No 2.733 resonance peak

Resonance peaks	$P^{31}(p,p')P^{31}$ 1.26 level		sd 90°
	(3.060)		
	(3.246)	3.73	
	3.58	3.79	

Many unresolved resonances with $3.57 < E_o < 4.00$

D.M.Van Patter, C.P.Swann, W.C.Porter, C.E. Mandeville, Phys. Rev. 103, 656 (1956).

S^{33} 16 17

Levels	$Cl^{(35)}(d,\alpha)$		$E_d = 3.0$ to 7.5
	g.s.	Q = 8.277 *10*	s
	0.844 *6*		
	1.966 *7*	3.840 *9*	
	2.312 *8*	3.947 *9*	
	2.869 *8*	4.060 *9*	
	2.938 *8*	4.105 *9*	
	2.969 *8*	4.159 *9*	
	3.227 *8*	4.224 *9*	
	3.365 *8*	4.749 *10*	

No 4.42 level observed. See also S^{35}

C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955).

Capture γ's	$S^{(32)}$(th n,γ)	scin Cp
56†	0.84 *2*	
1†	1.52 *5*	
37†	2.34 *3*	

Study covered $E_\gamma = 0.3$ to 3
†Photons/100 S captures, (±20%) ($\sigma_a = 0.49$)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

S^{34} 16 18

Levels	$Cl^{(37)}(p,\alpha)$		$E_p = 7.04$
	g.s.	Q = 3.026 *8*	s 90°, 130°
	2.127 *8*	4.114 *8*	
	3.302 *8*	4.621 *8*	
	3.915 *8*	4.685 *8*	
	4.073 *8*	4.876 *8*	

No 0.8 level

P.M.Endt, C.H.Paris, A.Sperduto, W.W.Buechner, Phys. Rev. 103, 961 (1956); Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

Levels	$Cl^{(37)}(p,\alpha)$		$E_p = 3.77$, 3.82
	g.s.	Q = 3.015 *11*	sd 90°
	2.129 *14*		

D.M.Van Patter, C.P.Swann, W.C.Porter, C.E. Mandeville, Phys. Rev. 103, 656 (1956); Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956).

Levels	$P^{31}(\alpha,p)$ $P^{31}(\alpha,p\gamma)$		
	g.s.	Q = 0.7 *1*	
	2.14 *2*	4.30 *6*	
	3.40 *5*	4.8 *1*	

No 0.8 level $1.20\gamma/3.33\gamma = 2.7$ *5*
Level energies are weighted averages of values found by scin p, scin γ, and abs p

G.S.Stanford, G.F.Pieper, Phys. Rev. 103, 637 (1956); 98, 1185A (1955).

S^{35} 16 19

Levels $Cl^{(37)}(d,\alpha)$ $E_d = 3.0$ to 7.5

g.s.	Q = 7.783 *12*	s
1.992* *10*	2.714 *10*	
2.348* *10*	4.025* *10*	

*From weak groups. Assignable to S^{33} or S^{35}

C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955).

S^{37} 16 21 5.0m

β^- (90%) 1.6 $A^{(40)}(n,\alpha)$; scin
(10%) ~4.7

$\gamma(Cl^{37})$
100† 3.12
No other γ with $E_\gamma < 2$ (< 1†)

H.Morinaga, E.Bleuler, Bull. Am. Phys. Soc. 1, No. 1, 30, H2 (1956); verbal report.

$\gamma(Cl^{37})$ 3.09 *3* $Cl^{(37)}$(fast n,p); scin

T.Stribel, Z. Naturf. 11a, 254 (1956).

Cl^{33} 17 16

Resonances $S^{(32)}(p,p)$ $E_p = 1.8$ to 4.0
62° to 167°; scin

E_o	Γ(kev)	J
1.900	8.5	$3/2^-$
2.30	52	$1/2^-$
2.575	≤5	
2.810	~6	$3/2^-$
2.902	≤5	
2.917	≤5	
3.092	≤4	$3/2^+, 5/2^+$
3.194	≤4	
3.265	32	$1/2^+$
3.381	≤4	$5/2^-, 7/2^-$
~3.5*	300	
3.718	≤4	

*Probably double

J.W.Olness, W.Haeberli, H.W.Lewis, Bull. Am. Phys. Soc. 1, No. 4, 212 SA14 (1956); verbal report.

Resonances $S^{(32)}(p,p'\gamma)$ $E_p = 2.7$ to 3.8
scin 2.2γ

2.810
2.902
2.917
3.094*
3.195*
3.379*
3.716*

*p,$\gamma(\theta)$ anisotropic, $\Gamma < 2$ kev

H.W.Lewis, J.W.Olness, W.Haeberli, Bull. Am. Phys. Soc. 1, No. 4, 213 SA15 (1956).

Cl^{34} 17 17 32m

τ 32.40m *4* $Cl^{(35)}$(18-Mev p,pn)
β^+ 26† 1.33 *10* sl
26† 2.48 *7*
47† 4.50 *3* F-K linear ($E_\beta > 3.0$)

D.Green, J.R.Richardson, Phys. Rev. 101, 776 (1956); 96, 858A (1954).

Cl^{34} 17 17 32m

$Cl^{(35)}$(20-Mev p,pn)
(1.16γ)(2.10γ)(θ) scin
Consistent with J = 2, 2, 0
and E2/M1 = 0.0177 *64* for 1.16γ

H.E.Handler, J.R.Richardson, Phys. Rev. 102, 833 (1956).

Cl^{35} 17 18

Levels $Cl^{(35)}(p,p')$ $E_p = 3.63$ to 3.83
1.219 *5* sd 90°
1.760 *4*

D.M.Van Patter, C.P.Swann, W.C.Porter, C.E. Mandeville, Phys. Rev. 103, 656 (1956); Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956).

Levels $Cl^{35}(p,p')$ $E_p = 4.6$ to 5.6
1.220 *5* S77
1.766 *5*

No 0.7 level

J.P.Schiffer, C.R.Gossett, G.C.Phillips, T.E.Young, Phys. Rev. 103, 134 (1956); Bull. Am. Phys. Soc. 1, No. 2, 95, N2 (1956).

Levels $Cl^{(35)}(p,p')$ $E_p = 7.04$

1.221 *5*	s 90°, 130°	
1.763 *5*	3.165* *8*	
2.645 *5*	4.058 *5*	
2.695 *5*	4.113 *5*	
3.006 *5*	4.174 *5*	

No 0.7 level
*Energy shift also permits assignment to Cl^{37}

P.M.Endt, C.H.Paris, A.Sperduto, W.W.Buechner, Phys. Rev. 103, 961 (1956); Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

Levels $Cl^{(35)}(n,n'\gamma)$ $E_n = 4.4$
γ 1.23 *1* scin
1.77 *1*

R.M.Sinclair, Westinghouse Research Report 60-94511-6-R12 (1956).

Cl^{36} 17 19 3.1×10^5y

β^- 0.714 *4* 4π scin
For $E_\beta > 0.089$ shape is fitted with $\Delta J = 2$ no, $R_{ij}/T_{ij} = 0$ and $A_{ij}/T_{ij} = 14.2$

R.G.Johnson, O.E.Johnson, L.M.Langer, Phys. Rev.102, 1142 (1956); Bull. Am. Phys. Soc. 1, No. 4, B1 162 (1956).

β^- 98.3% (0.714) CH_3Cl in pc
ϵ_K 1.7% (K x ray + e_{AK})/β = 0.017 *1*
No γ (<10^{-2}%) scin, pc ce

R.W.P.Drever, A.Moljk, Phil. Mag. 46, 1337 (1955).

Cl^{36} 17 19

Levels $K^{(39)}(n,\alpha)$ E_n = 2.0 to 5.5

g.s.	Q = 1.25 *20*	KI scin	
0.87 *10*			

M.J.Scott, R.E.Segel, Phys. Rev. 102, 1557 (1956).

Levels $Cl^{(35)}(d,p)$ E_d = 3.0 to 7.5

g.s.	Q = 6.354 *8*		s
0.790 *5*		3.110 *8*	
1.163 *6*		3.214 *8*	
1.600 *7*		3.341 *8*	
2.473 *7*		3.474 *8*	
2.498 *7*		3.606 *8*	
2.523 *7*		3.644 *8*	
2.684 *7*		3.673 *8*	Cl^{38}?
2.820 *7*		3.732 *8*	
2.872 *7*		3.970 *8*	
2.905 *7*		4.003 *8*	
3.004 *7*		4.043 *8*	

C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955).

Capture γ's $Cl^{(35)}$(th n,γ) scin Cp

10†	0.48 *3*	34†	1.96 *3*
10†	0.75 *3*	1†	2.42 *5*
8†	1.14 *3*	6†	2.84 *3*

Study covered E_γ = 0.3 to 3

†Photons/100 Cl captures, (± >20%)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

Resonances $Cl^{(35)}$(n) E_n = 0.03 to 15000 ev

-140 ev	Γ_n = 0.72* ev	Γ_γ = 0.48*	
405 *6*	Γ_n = 0.14$^\$$		
8700			cryst, chopper

*Assuming J = 2 $^\$$From Γ < 0.6 and σ_o > 580

R.M.Brugger, J.E.Evans, E.G.Joki, R.S. Shankland, Bull. Am. Phys. Soc. 1, No. 4, 176 F11 (1956); verbal report.

Cl^{37} 17 20

Levels $Cl^{(37)}(p,p')$ E_p = 7.04

0.838 *5*	s	90°, 130°
1.728 *5*		
3.087* *8*		
3.105* *8*		

*Energy shift also permits assignment to Cl^{35}

P.M.Endt, C.H.Paris, A.Sperduto, W.W.Buechner, Phys. Rev. 103, 961 (1956); Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

Level $Cl^{37}(p,p')$ E_p = 4.6 to 5.6

1.713 *10*	s77

J.P.Schiffer, C.R.Gossett, G.C.Phillips, T.E.Young, Phys. Rev. 103, 134 (1956); Bull. Am. Phys. Soc. 1, No. 2, 95, N2 (1956).

Cl^{38} 17 21

Levels $Cl^{(37)}(d,p)$ E_d = 3.0 to 7.5

43†	g.s.	Q = 3.877 *8*	s
100†	0.672 *5*	1.620 *7*	
	0.762 *5*	1.658 *7*	
	1.312 *6*	1.693 *7*	

†Relative intensity for E_d = 5.6, compatible with $J = 2^-, 5^-$ for g.s., 0.672 levels resp.

C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955).

Cl^{39} 17 22 56m

β^-	93.5%	1.90 *5*	$A^{(40)}(\alpha,\alpha p)$; sl
	6.5%	3.43 *5*	
$\gamma(A^{39})$	100†	0.246	scin
	100†	1.266 *10*	
	84†	1.520 *10*	

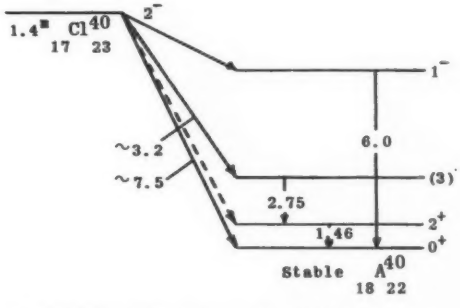
β(high E_γ) delay = 0.95 mμs *5*

(0.246 γ)(1.27 γ) No (1.52 γ)γ

J.R.Penning, H.R.Maltrud, J.C.Hopkins, F.H. Schmidt, Bull. Am. Phys. Soc. 1, No. 4, 162 B2 (1956); verbal report.

Cl^{40} 17 23 1.4m

τ		1.4m	$A^{(40)}$(fast n,p) chem
β^-		~3.2	scin
		~7.5	
$\gamma(A^{40})$	100†	1.46	scin
	100†	2.75	
		6.0	



H.Morinaga, Phys. Rev. 103, 504 (1956); H.Morinaga, E.L.Robinson, E.Bleuler, Bull. Am. Phys. Soc. 1, No. 4, 162 B3 (1956).

A^{35} 18 17 1.8s

$Cl^{(35)}$(10-Mev p,n) chem

τ		1.83s *2*	
β^+	~93%	4.96 *4*	sl
$\gamma(Cl^{35})$			
	≤3%	1.19 *4*	scin
	≤3%	1.73 *4*	

O.C.Kistner, A.Schwarzschild, B.M.Rustad, Bull. Am. Phys. Soc. 1, No. 1, 30, H3 (1956).

A^{37} 18 19 34d

E_ϵ		0.812 *8*	s Cl^{37} recoil
e_{AK}	65%		

Charges 1 to 6 (av. = 2.6) found on recoils

Continued

A^{37} 18 19 34^{d} — Continued

Charge distribution and ϵ_L/ϵ_K value are discussed elsewhere*

O. Kofoed-Hansen, A. Nielsen, Kgl. Danske Videnskab. Selskab Mat.-fys. Medd. 29, No. 15 (1955); Phys. Rev. 96, 1045 (1954). *A. Winther, J. phys. radium 16, 562 (1955); R. A. Rubenstein, J. N. Snyder, Phys. Rev. 99, 189 (1955); P. Benoist-Gueutal, Ann. Phys. 8, 593 (1953).

E_ϵ **0.814** *2* s Cl^{37} recoil

Charges 1 to 7 (av. = 3.2) found on recoils

A. H. Snell, P. Pleasonton, Phys. Rev. 100, 1396; 98, 1174A; 97, 246 (1955).

ϵ scin γ continuum

High intensity of photons, $E_\gamma < 0.030$, supports theory of Glauber and Martin*

T. Lindqvist, C.S. Wu, Phys. Rev. 100, 145; 98, 231A (1955); *R.J. Glauber, P.C. Martin, Phys. Rev. 95, 572 (1954).

For $E_\gamma > 0.035$ γ continuum has allowed shape and intensity is 1.05 ± 0.25 times theoretical value

B. Saraf, Phys. Rev. 102, 466 (1956).

A^{39} 18 21 — Levels $K^{(39)}(n,p)$ $E_n = 2.0$ to 5.5

g.s.	(Q = 0.20)	KI scin
1.24 *5*		
2.46 *10*		

No 1.52 level (yield < 1/3 that of 1.24 level)

M. J. Scott, R. E. Segel, Phys. Rev. 102, 1557 (1956).

A^{41} 18 23 1.8^{h}

τ		**1.8**^{h}	$A^{(40)}$(pile n,γ)	
β^-	99.1%	**1.199** *8*	F-K linear	($E_\beta > 0.15$)
	0.88%	**2.48** *4*	$\Delta J = 2$, yes shape	sl, sπ
$\gamma(K^{41})$		**1.290** *5*		sc$\bar{i}$n

A. Schwarzschild, B. M. Rustad, C. S. Wu, Bull. Am. Phys. Soc. 1, No. 1, 30, H4 (1956).

A^{41} 18 23 — Levels $A^{(40)}$(d,p) $E_d = 8.4$ s d,p(θ)

	Level	l_n
130†	g.s.	3
20†	**0.57** *5*	1
w	**1.11** *10*	
100†	**1.39** *5*	1
w	**1.93** *10*	
19†	**2.46** *5*	1
17†	**2.79** *5*	1
18†	**3.01** *5*	1
28†	**3.36** *5*	1
27†	**3.98** *5*	1

† Relative values of $\int \sigma d\theta$

H. B. Burrows, T. S. Green, S. Hinds, R. Middleton, Proc. Phys. Soc. 69A, 310 (1956).

K 19 — Relative isotopic abundances ms

K^{39}	**93.23%**	*5*
K^{40}	**0.0118%**	*2*
K^{41}	**6.76%**	*5*

No K^{36}, K^{37}, K^{38} ($< 8 \times 10^{-6}$%)

No K^{42} ($< 4 \times 10^{-6}$%) No K^{43} ($< 2 \times 10^{-6}$%)

F. A. White, T. L. Collins, F. M. Rourke, Phys. Rev. 101, 1786 (1956).

K^{37} 19 18 1.2^{s}

τ	**1.2**^{s}	$Ca^{(40)}$(12.8-Mev p,α)
β^+	**5.1**	sπ

C. R. Sun, B. T. Wright, Bull. Am. Phys. Soc. 1, No. 5, 253 F8 (1956).

K^{38} 19 19 7.7^{m}

τ	**7.7**^{m} *3*	$K^{(39)}$(18-Mev p,pn)
β^+	**2.68** *3*	sl
No ce	No 4.9 β^+ (< 0.6%)	

D. Green, J. R. Richardson, Phys. Rev. 101, 776 (1956); 96, 858A (1954).

K^{39} 19 20 — Levels $A^{36}(\alpha,p)$ $E_\alpha = 7.4$

g.s.	Q = −1.28 *3*	ppl 90°
2.50		
2.87		

R. B. Schwartz, J. W. Corbett, W. W. Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955).

$K^{(39)}(p,p')$ $E_p = 4.6$ to 5.6

No level below 2.0 sπ

J. P. Schiffer, C. R. Gossett, G. C. Phillips, T. E. Young, Phys. Rev. 103, 134 (1956).

K^{40} 19 21 1.3×10^{9y}

τ	**1.28x10**^{9y} *2*	
$\gamma(A^{40})$	**1.46** *1*	scin
27.5 *3* β's/sec g K		pc β
$\gamma/\beta = 0.124$ *2*	Co^{60} standard	pc β, scin γ
= 0.121 *4*	Na^{24} standard	

A. McNair, R. N. Glover, H. W. Wilson, Phil. Mag. 1, 199 (1956); Phys. Rev. 99, 771 (1955).

3.50 ± 0.14 γ's/sec gm K scin

Absolute count (Pr^{142}, Co^{60}, Fe^{59} standards)

G. Backenstoss, K. Goebel, Z. Naturf. 10a, 920 (1955).

ϵ/sec gm K = 3.24* *15*

β/sec gm K = 27.6$ *30*

*From A^{40}/K^{40} in 4 samples of micas of young Pb/U ages. Result insensitive to specific β activity of K^{40}

$From A^{40}/K^{40} in 8 samples of micas of older ages and above value of ϵ/sec gm K

G. W. Wetherill, G. J. Wasserburg, L. T. Aldrich, G. R. Tilton, R. J. Hayden, Phys. Rev. 103, 987 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31, H5 (1956).

K^{40} 19 21

Capture γ's — $K^{(39)}$(th n,γ) — scin Cp

24†	**0.77** *3*	13†	**2.03** *3*
8†	**1.19** *3*	6†	**2.80** *3*
5†	**1.61** *3*	8†	**3.45** *5*

†Photons/100 K captures, ±20% (σ_a = 1.89)
(Max in K^{40}, K^{41}, K^{42} = 95.5, 0.4, 4.1†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

γ — $Ca^{(40)}$(n,pγ) — E_n = 3.95 scin

σ(95°)	E_γ
10 *5*	**0.030** *2*
5.8 *15*	**0.767** *7*
0.6 *3*	**0.877** *17*

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

K^{42} 19 23 12.5^h

β^-	1†	**0.5 ?**	K^{41}(pile n,γ); sl
	100†	**1.985** *10*	F-K linear
		3.545 *10*	ΔJ = 2, yes shape

γ(Ca^{42})

0.8††	**0.320** *5*	sl pe
100††	**1.53** *1*	

A.V.Pohm, R.C.Waddell, E.N.Jensen, Phys. Rev. 101, 1315 (1956).

K^{43} 19 24

Levels — A^{40}(α,p) — E_α = 7.4 ppl 90°

g.s.	Q = −**3.36** *3*
0.65	
1.18	

R.B.Schwartz, J.W.Corbett, W.W.Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955).

Ca^{40} 20 20

Levels — $Ca^{(40)}$(p,p'γ) E_p = 6.54 to 8.15 — sπ 90°

3.348 *4*	**5.272** *6*
3.730 *4*	**5.606** *9*
3.900 *4*	**5.621** *8*
4.483 *5*	**5.901** *8*
5.202 *8*	**6.029** *8*
5.241 *6*	

C.M.Braams, Phys. Rev. 101, 1764 (1956).

Levels — $Ca^{(40)}$(n,n'γ) — E_n = 3.95 scin

σ(95°)	
	3.36* *5*
γ 6 *2*	**3.74** *3*
3 *1*	**3.9** *1*

*Threshold for $\gamma^{\pm}$ — σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Ca^{41} 20 21

Capture γ's — $Ca^{(40)}$(th n,γ) — scin Cp

15†	**0.48** *5*
45†	**1.93** *3*

Study covered E_γ = 0.3 to 3

Continued

Continued

†Photons/100 Ca captures, ± 20%

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Ca^{44} 20 24

Level — $Ca^{(44)}$(n,n'γ) — E_n = 3.95 scin

σ(95°)	Level
γ 90 *20*	**1.152** *20*

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Ca^{47} 20 27 4.8^d

τ		**4.5**^{d}	$Ca^{(48)}$ (14-Mev p,pn) Ca^{46}(pile n,γ) chem
β^-	76%	**0.70** *2*	a $\beta\gamma$
	24%	**1.93** *20*	a
γ(Sc^{47})	5%	**0.500**	4π pc,scin
	5%	**0.812**	
	71%	**1.29**	

(0.70 β)(0.50, 0.81, 1.29 γ)
(0.50 γ)(0.81 γ) No (1.9 β)γ No γ(1.29 γ)

W.S.Lyon, T.H.Handley, Phys. Rev. 100, 1280 (1955).

Ca^{48} 20 28

$\tau_{\beta\beta}$		84.28% Ca^{48}; 4π scin
	> **2x10**^{18}y	$\beta\beta$
	> **1.1x10**^{18}y	β

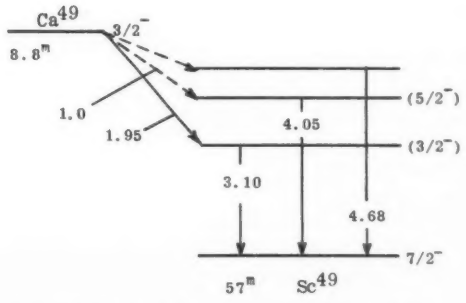
Search covered $3.0 < E_\beta < 4.75$
Long τ suggests ν and anti-ν are nonidentical

M.Awschalom, Phys. Rev. 101, 1041 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31, H7 (1956).

Ca^{49} 20 29 8.8^m

τ		**8.75**^{m} *20*	Ca^{48}(pile n,γ)
β^-	14†	**0.89** *15*	scin
	100†	**1.95** *5*	
γ(Sc^{49})			
	100††	**3.10** *3*	scin
	11††	**4.05** *5*	
	0.38††	**4.68** *5*	

β/(3.10 γ) = 0.95 *10* — 4π ic,scin
No (3.10 γ)(4.05, 4.68 γ) No 0.95γ (< 2†)



G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 101, 1059 (1956).

$^{49}_{20}Ca_{29}$ 8.8^{m}

τ	8.9^{m} 2	Ca^{48}(pile n,γ)	
β^-	~1.0	a$\beta\gamma$	
	2.12 *10*		
$\gamma(Sc^{49})$ 85†	3.07 *5*	scin	
10†	4.04 *6*		
0.8†	4.7 *1*		
(~1.0β)(4.04γ)	(2.12β)(3.07γ)		
No 5.2β (< 1%)	No 0.98γ (< 3†)		
No $\gamma\gamma$			

D.W.Martin, J.M.Cork, S.B.Burson, Phys. Rev. 102, 457 (1956); 100, 1236A (1955).

Sc $_{21}$

Relative isotopic abundances ms

Sc^{45} **100.0%**

No Sc^{42}, Sc^{43}, Sc^{44}, Sc^{46} (< 0.010%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$^{42}_{21}Sc_{21}$ 0.6^{s}

τ	0.62^{s} 5	$K^{(39)}$(18-Mev α,n)	
β^+	Several Mev	scin	

Yield too large for Ti^{43} production from Ca impurity. τ fits systematics for $0^+ \rightarrow 0^+$

H. Morinaga, Phys. Rev. 100, 431 (1955).

$^{44}_{21}Sc_{23}$ 4.0^{h} g.s.

		$K^{(41)}$(19-Mev α,n) chem	
β^+ 93.2†	1.471 *5*	sl $\beta\gamma/\gamma$	
		F-K linear ($E_\beta > 0.200$)	
$\gamma(Ca^{44})$		scin	
100†	1.159 *3*	$\alpha = 6.3\times10^{-5}$	sl ce
0.12†	2.54 *3*		
(1.47β)(1.16γ)		sl,scin	
No 1.38γ (≤ 0.5†)			

Intensity of e's with E < 0.15 compatible with value expected for atomic excitation

J.W.Blue, E.Bleuler, Phys. Rev. 100, 1324; 99, 659A (1955).

$^{44}_{21}Sc_{23}$ 2.4^{d}

$\gamma(Sc^{44})$	(0.271)	α = 0.139 *3*	sl ce,scin

J.W.Blue, E.Bleuler, Phys. Rev. 100, 1324; 99, 659A (1955).

$^{45}_{21}Sc_{24}$

Levels	Sc^{45}(n,n'γ)	E_n = 0.35 to 3.9	
γ	0.36	0.97	scin
	0.53	1.23	
	0.72	1.41	

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$^{46}_{21}Sc_{25}$ 84^{d} g.s.

β^- 0.0036%*	1.475 *6*	F-K not linear	sl

*Assuming $\alpha = 9.86\times10^{-5}$ for 1.12γ and shape factor $p^2 + 0.6q^2$

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

$^{46}_{21}Sc_{25}$ 84^{d} g.s.

		Sc^{45}(slow n,γ)	
$\gamma(Ti^{46})$	0.892 *3*	scin	
	1.118 *3*		

K.E.Johansson, Arkiv Fysik 10, 247 (1956).

Sc^{45}(pile n,γ) chem

(1.12γ)(0.89γ)(θ) scin

Consistent with J = 4, 2, 0

G.Bertolini, M.Bettoni, E.Lazzarini, Nuovo Cim. 3, 800 (1956).

$^{47}_{21}Sc_{26}$ 3.4^{d}

		$Ti^{(48)}$(γ,p) chem	
β^- 64%	0.430 *5*	sl$\beta\gamma$	
36%	0.596 *10*	sl	
$\gamma(Ti^{47})$	0.167 *2*	scin	
(0.430β)γ	No ce		

R.T.Nichols, E.N.Jensen, Phys. Rev. 100, 1407 (1955).

		Ca^{44}(23-Mev α,p) chem	
β^- 60%	0.439 *2*	sl,scin	
40%	0.600 *2*		
$\gamma(Ti^{47})$	0.159 *2*	$\beta\gamma$ delay < 0.04$^{\mu s}$	
		sl pe,scin	
(0.439β)γ	No (0.600β)γ	scin	

W.E.Graves, S.K.Suri, Phys. Rev. 101, 1368 (1956).

$^{48}_{21}Sc_{27}$ 1.8^{d}

$\beta\gamma$ delay < 0.1$^{\mu s}$	$V^{(51)}$(d,αp) chem	
(1.04γ)(1.33γ)(θ) J = 6, 4, 2, 0	scin	
(1.04γ)(0.99$\gamma\gamma$)(θ)		

B.Van Nooijen, P.Mostert, J.F.Van der Brugge, P.M.Endt, Physica 22, 194 (1956).

$^{49}_{21}Sc_{28}$ 57^{m}

τ	57.2^{m} 7	$Ca^{(48)}$(pile n,$\gamma\beta$) chem	
β^- 100%	2.05 *5*	scin	
No 1.35γ (< 0.05%)		bremsstrahlung/β	
No other γ			

G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 101, 1059 (1956).

β^-	1.8 *1*	Ca^{48}(pile n,$\gamma\beta$); a	

D.W.Martin, J.M.Cork, S.B.Burson, Phys. Rev. 102, 457 (1956).

$^{50}_{21}Sc_{29}$ 1.7^{m}

τ	1.74^{m} 4	Ti^{50}(fast n,p)	
β^- ~1†	~3.5	scin	
$\gamma(Ti^{50})$ ~1†	1.17	scin	
1†	1.59		
(1.17γ)(1.59γ)		Σscin	

H.Morinaga, E.Bleuler, Phys. Rev. 100, 1236A (1955); verbal report.

Ti 22

Capture γ's Ti(th n,γ) scin Cp

0.334 *6*	
1.39 *2*	
1.75 *4*	

Also unresolved γ's with $1.06 < E_\gamma < 1.10$ and $1.53 < E_\gamma < 1.58$

Study covered $E_\gamma = 0.1$ to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

Ti^{45} 22 23

Level Sc^{45}(p,n) E_p = 2.9 to 5.5; VdG

Level	thresh n, ~0°
g.s.	Q = −2.844 *4*
0.743 *11*	
1.194 *8*	
1.347 *10*	
1.460 *11*	
1.876 *10*	
2.016 *13*	
2.430 *11*	
2.555 *8*	

Graph of σ(~0°) given for n yield

R.M.Brugger, T.W.Bonner, J.B.Marion, Phys. Rev. 100, 84 (1955).

Ti^{48} 22 26

Level $Ti^{(48)}$(n,n′) E_n = 2.25, 2.45

$Ti^{(48)}$(n,n′γ) pulsed n's

σ(90°)	Level	
85° *3*	1.02 *3*	n,n′(θ), n,γ(θ)

Both angular distributions change with E_n

For E_n = 2.45 σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Ti^{49} 22 27

Capture γ's $Ti^{(48)}$(th n,γ) scin Cp

29†	0.33 *2*
90†	1.40 *3*
≤10†	~1.7

Study covered E_γ = 0.3 to 3

†Photons/100 Ti captures, (±20%)

(Max in Ti^{47}, Ti^{48}, Ti^{49}, Ti^{50}, Ti^{51} = 0.7, 2.2, 95, 1.7, 0.3†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 335A (1953).

V 23

Relative isotopic abundances ms

V^{50}	0.25% *1*
V^{51}	99.75% *1*

No V^{48} ($< 1 \times 10^{-4}$%) No V^{49} ($< 5 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

V^{48} 23 25 16^d

Fe(160-Mev p) chem

(1.32 γ)(0.99 γ)(θ)
(2.23 γ)(0.99 γ)(θ)
(1.32 γ)(0.99 γ)(⊥) } J = 4, 4^+, 2^+, 0^+ scin

J = 3, 4^+, 2^+, 0^+ cannot definitely be excluded

γ(0.99γ) delay < 20 $\mu\mu$s

C.P.Coleman, Phys. Rev. 103, 647 (1956).

V^{50} 23 27

τ_{ϵ_K} $> 5 \times 10^{13}$y natural V

$> 3 \times 10^{15}$y

No Ti K x rays observed pc

R.Bauminger, Bull. Research Council Israel 5A, 163A (1956).

V^{50} 23 27

Level $V^{50}(\alpha,\alpha'\gamma)$ E_α = 4.4

γ 0.226 ϵB(E2) = 0.011 scin

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

Level $V^{50}(\alpha,\alpha'\gamma)$ E_α = 6.5

γ 0.225 ϵB(E2) = 0.011 scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

V^{51} 23 28

	ground state
q	+0.28 *15*

S

K.Murakawa, J. Phys. Soc. Japan 11, 422 (1956).

Level $V^{(51)}(\gamma,\gamma)$ Cr^{51} recoil

(0.320) $\tau = 100^{\mu\mu s}$ *20* σ

H.Schopper, Z.Phys. 144, 476 (1956).

Levels $V^{(51)}$ (p,p′) E_p = 6.005, 7.420

0.322 *2*	s 90°, 130°
0.931 *3*	
1.614 *5*	
1.819 *5*	

No evidence for levels at 0.48, 1.16

W.W.Buechner, C.M.Braams, A.Sperduto, Phys. Rev. 100, 1387 (1955).

Levels $V^{(51)}$(n,n′) E_n = 2.45

σ(90°)	Level	pulsed n's
16 *1*	0.92 *3*	
18 *2*	1.63 *3*	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

γ $V^{(51)}$(n,n′γ) E_n = 2.5; scin

0.32 *2*	
0.48?	1.62 *4*
0.92 *4*	1.83 *4*

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

V^{52} 23 29

Capture γ's $V^{(51)}$(th n,γ) scin Cp

5†	0.42 *3*	8†	0.84 *3*
6†	0.63 *3*	5†	2.25 *3*

Study covered E_γ = 0.3 to 3

†Photons/100 V captures, (±20%) (σ_a = 4.7)

(Max in V^{51}, V^{52} = 12, 88†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

V^{52} 23 29

Capture γ's $V^{(51)}$(th n,γ) scin Cp

0.43 2
0.64 2
~**0.82** double?

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

V^{53} 23 30 1.7^m

τ		**1.7**^{m}	Cr^{53}(5.3-Mev n,p)
β^-		**2.53** 5	scin
$\gamma(Cr^{53})$	st	**1.00** 1	scin
	w	**1.29**	

A.W.Schardt, B.J.Dropesky, Bull. Am. Phys. Soc. 1, No. 4, 162 B4 (1956); verbal report.

V^{54} 23 31 55^s

τ		**55**^{s} 5	Cr^{54}(16-Mev n,p)
β^-		**3.3** 2	scin
$\gamma(Cr^{54})$		**0.835** 9	**0.9** $< E_\gamma <$ **2.2** scin
		0.990 10	**2.25**

0.835 γ more intense than 0.990 γ
(0.835 γ)(0.990 γ)($E_\gamma > 1$)

A.W.Schardt, B.J.Dropesky, Bull. Am. Phys. Soc. 1, No. 4, 162 B4 (1956); verbal report.

Cr 24

Levels Cr(n,n') E_n = 4.3; scin pulsed n's,90°

1.4
2.5
2.9
3.1 ?

R.V.Smith, Bull. Am. Phys. Soc. 1, No. 4, 175 F2 (1956); verbal report.

Level	Cr(n,n')	E_n = 2.45
σ(90°)	Level	pulsed n's
48 3	**1.49** 3	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Level	Cr(n,n'γ)	E_n = 2.5
σ = 0.6	**1.45** 5	scin n
γ	**1.44** 3	scin γ

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

Capture γ's Cr(th n,γ) scin Cp

2†	**0.52** 3		
40†	**0.83** 3	10†	**2.28** 3
6†	**1.84** 3	4†	**3.04** 3

Study covered E_γ = 0.3 to ~3
†Photons/100 Cr captures, ±20% (σ_a = 2.99)
(Max in Cr^{51},Cr^{53},Cr^{54},Cr^{55} = 23, 20, 56, 0.2†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Cr 24

Capture γ's Cr(th n,γ)

0.740 20		**1.07** 6	scin Cp
0.815 16		**2.13** 5	

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

Cr^{48} 24 24 24^h

τ		**23**^{h} 1	Ni(380-Mev p) chem
$\gamma(V^{48})$	95†	**0.116** 2	α = 0.02 M1 scin,
	100†	**0.305** 10	α = 0.006 E2 sl ce

No β^+ (< 2† from $\gamma^\pm$ < 1†) scin
No 0.420 γ (< 2†) No other γ
(0.116 γ)(0.305 γ) p $16^d V^{48}$

R.van Lieshout, D.H.Greenberg, L.A.Ch.Koerts, C.S.Wu, Phys. Rev. 100, 223; 98, 1171 (1955).

Cr^{51} 24 27 27^d

E_ϵ **0.752** 22 scin γ continuum

J.B.Van der Kooi, H.J.Van den Bold, Physica 22, 681 (1956).

$Cr^{(50)}$(pile n, γ) chem

E_ϵ **0.780** 50 scin γ continuum
$\gamma(V^{51})$ 7% **(0.320)** (0.320 γ)/(γ continuum)

S.G.Cohen, S.Ofer, Phys. Rev. 100, 856 (1955).

$Cr^{(50)}$(pile n,γ) chem

E_ϵ (92.2%) **0.756** 5 γ continuum
$\gamma(V^{51})$ scin
9.8% **(0.320)** (0.320 γ)/(K x ray)
0.026% **0.624** 5

A.Bisi, E.Germagnoli, L.Zappa, Nuovo. cim. 2, 1052 (1955).

$\gamma(V^{51})$ **(0.320)** α = 0.0031 2 E2 GM

I.V.Estulin, E.M.Moiseeva, Soviet Phys. JETP 1, 463 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 541 (1955).

$\gamma(V^{51})$ **0.325** α = 0.0015 2 sl ce,Cp

Z.O'Friel, A.H.Weber, Phys. Rev. 101, 1076 (1956).

$\gamma(V^{51})$ 9.8% **(0.323)** α = 0.00162 16 scin,
$x\gamma/x$ = 0.098 6 M1 + E2 sl ce

M.E.Bunker, J.W.Starner, Phys. Rev. 97, 1272 (1955); 99, 1906 (1955).

Cr^{52} 24 28

Levels $Cr^{(52)}$(n,n') E_n = 4.4

37†	**g.s.**	ppl p-recoil
14†	**(1.45)**	
~5†	**(2.43)**	
~14†	**(3.13)**	

†σ(90°) in mb/sterad

J.B.Weddell, B.Jennings, Bull. Am. Phys. Soc. 1, No. 1, 55, R5 (1956); verbal report.

Cr^{52} 24 28

Resonance peaks — $V^{51}(p,n)$ — $E_p = 1.55$ to 1.65

E_o $	E_o $
1.568*	**1.629***
1.573*	**1.637***
1.575	**1.651**
1.592**	**1.658***
1.598**	**1.669***
1.603*	**1.672**
1.607*	
1.617*	

Threshold = 1.5656 *15*

*p,n(θ) isotropic **p,n(θ) anisotropic

E_p values for isolated resonances

J.H.Gibbons, R.L.Macklin, H.W.Schmitt, Phys. Rev. 100, 167 (1955).

Cr^{53} 24 29

Levels — $Cr^{52}(d,p)$ — $E_d = 10$ a pc

Level	l_n		
g.s.	*1*	Q = **5.74**	d,p(θ)
0.57	*1*		
0.97	*3*		
2.31	*1*		

A.J.Elwyn, F.B.Shull, Bull. Am. Phys. Soc. 1, No. 6, 281 B7 (1956).

Resonance peaks — $Cr^{(52)}(n,n)$ — $Li(p,n)$; n,n(θ)

0.058	J = $1/2^+$	$l_n = 0$
0.100	= $1/2^+$	= 0

R.C.Block, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 55, R3 (1956).

Cr^{54} 24 30

Levels — $Cr^{53}(d,p)$ — $E_d = 10$ a pc

Level	l_n		
g.s.	*1*	Q = **7.55**	d,p(θ)
0.86	*1*		
1.31	*1*		
2.67	*1*		
3.19	*1*		
3.79	*1*		

A.J.Elwyn, F.B.Shull, Bull. Am. Phys. Soc. 1, No. 6, 281 B7 (1956).

Cr^{55} 24 31 3.5^m

No γ ($< 0.01\%$) — $Cr^{54}(n,\gamma)$

T.H.Handley, S.A.Reynolds, CF-56-3-65; Nuclear Sci. Abstr. 10, No. 3243 (1956).

Mn 25

Relative isotopic abundances — ms

Mn^{55} **100.0%**

No Mn^{53} ($< 4 \times 10^{-4}\%$) No Mn^{54} ($< 3 \times 10^{-4}\%$)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Mn^{52} 25 27 5.7^d g.s.

(0.73 γ)(θ,T)
(0.94 γ)(θ,T)
(1.46 γ)(θ,T)
} J = 6, 4, 2, 0 — scin

W.J.Huiskamp, M.J.Steenland, A.R.Miedema, H.A.Tolhoek, C.J.Gorter, Physica 22, 587 (1956).

Mn^{52} 25 27 21^m

β^+ **2.631** *15* — $8.3^h Fe^{52}$ source — F-K linear — sd

E.Arbman, N.Svartholm, Arkiv. Fysik 10, 1 (1956).

Mn^{54} 25 29 291^d g.s.

E_ϵ **0.528** *20* — x(continuum γ)

R.G.Jung, M.L.Pool, Bull. Am. Phys. Soc. 1, No. 4, 172 E11 (1956).

Mn^{54} 25 29

Mn^{55}($\leq$ 24-Mev γ,n)

No 2.1^m activity ($\int \sigma dE < 0.1$ mb Mev)

J.Goldemberg, Acad. Brasileira Ciencias 27, LIV (1955).

Mn^{55} 25 30

Level — $Mn^{55}(\alpha,\alpha'\gamma)$ — $E_\alpha = 3$

0.128 level J = $7/2^-$ — p,γ(θ)

γ **(0.128)** $\alpha_K = 0.0144$* *30* — s ce

M1 ($\gtrsim 98\%$)

*From (α_K 0.137γ Ta^{181})/(α_K 0.128γ Mn^{55}) = 125 *25*

E.M.Bernstein, H.W.Lewis, Phys. Rev. 100, 1367 (1955).

Level — $Mn^{55}(n,n'\gamma)$ — $E_n = 0.13$ to 2

γ **(0.128)** — scin γ

Graph of σ from threshold $< E_n <$ 2

Hanser-Feshbach theory for σ favors J = $9/2^-$

J.B.Guernsey, A.Wattenberg, Phys. Rev. 101, 1516 (1956).

γ — $Mn^{55}(n,n'\gamma)$ — $E_n = 0.2$ to 1.2

(0.128)* — scin γ

0.84 *4*

*Hauser-Feshbach theory for σ favors J = $7/2^-$

J.J.Van Loef, D.A.Lind, Phys. Rev. 101, 103 (1956); 99, 621A; 98, 224A (1955).

Levels — $Mn^{55}(n,n'\gamma)$ — $E_n = 2.5$

σ = 0.4	**0.94** *5*		scin n
0.3	**1.37** *5*		
0.1	**1.65** *5*		
γ	**0.126** *5*		scin γ
	0.32 *2*	**1.53** *3*	
	0.86 *3*	**1.87**?	
	1.21 *3*	**2.27** *4*	

(0.126 γ)(0.86, 1.21, 1.53, 2.27 γ) — scin

No (0.126 γ)(1.87 γ)

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

Levels — $Mn^{55}(n,n')$ — $E_n = 2.45$

σ(90°)	Level		
20 *2*	**0.98** *4*		pulsed n's
11 *1*	**1.29** *3*		
12 *2*	**1.53** *3*	σ units: mb/sterad	

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Mn^{56} 25 31 2.6^h

$\gamma(Fe^{56})$ **0.845** *6* **1.809** *9* **2.134** *11* Mn^{55}(th n,γ); scin

M.G.Muñoz, D.Maeder, Helv. Phys. Acta 28, 359A (1955).

Mn^{56} 25 31

Capture γ's Mn^{55}(th n,γ) scin Cp

0.098 *5* **0.206** *10* **0.266** *15* **0.308** *15*

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

Resonances Mn^{55}(n) E_n = 0.175 to 10 kev

σ(peak)	E_o(kev)	Γ(ev)	J	chopper
2830	**0.337** *3*	21.5	2	
	1.08 *2*	14.4	3	
702	**2.36** *6*	340	3	
	7.50			

Γ_γ assumed to be 0.6 ev

L.M.Bollinger, D.A.Dahlberg, R.R.Palmer, G.E.Thomas, Phys. Rev. 100, 126 (1955); 95, 645A (1954).

Fe 26 Levels Fe(n,n') E_n = 4.3; scin pulsed n's

g.s. **0.8** **2.2** **3.1**

R.V.Smith, Bull. Am. Phys. Soc. 1, No. 1, 55, R6 (1956); verbal report.

Capture γ's Fe(th n,γ) scin Cp

0.355 *8*

Also unresolved γ's with $1.55 < E_\gamma < 1.68$

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

γ Fe(n,n'γ) E_n = 2.56 scin

σ(95°)	E_γ
1.0 *2*	**0.123** *1*
68 *5*	**0.847** *8*
3.3 *4*	**1.241** *12*
3.7 *4*	**1.405** *10*
0.4 *1*	**2.18** *6*
0.2 *1*	**2.3** *1*

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

γ Fe(n,n'γ) E_n = 3.7 scin

σ(100°)	E_γ
135 *27*	**0.84** *2*
24 *5*	**1.25** *2*
25 *5*	**1.81** *2*
30 *6*	**2.06** *2*
7 *1*	**2.57** *2*
14 *3*	**3.07** *2*
21 *4*	**3.44** *2*

σ units: mb/sterad

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

Fe 26 Resonance peaks

	Fe(n) E_o(kev)	I_n		Li(p,n) E_o(kev)	I_n
st	**8.0**		w	**36 ?**	
w	**16 ?**		st	**74.5**	0
st	**28.8**	0	st	**84.5**	0

J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

Fe^{52} 26 26 8.3^h Ni(160-Mev p) chem

β^+ **0.804** *10* P-K linear sd

$\epsilon/\beta^+ = 0.8$ *2* from $\beta^+(Fe^{52})/\beta^+(21^m Mn^{52}) = 0.57$ *6* assuming 100% of Fe^{52} decays to $21^m Mn^{52}$

E.Arbman, N.Svartholm, Arkiv Fysik 10, 1 (1956).

Fe^{54} 26 28 Levels $Fe^{(54)}(p,p')$ E_p = 7.04 sd; 30°,130°

1.41 **2.54** **2.57** **3.16** **3.34**

W.W.Buechner, A.Sperduto, Bull. Am. Phys. Soc. 1, No. 1, 39, JA3 (1956).

Level $Fe^{(54)}(n,n'\gamma)$ E_n = 2.56 scin

σ(95°)	Level
63 *7*	**1.405** *10*

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Fe^{55} 26 29 2.9^y For $E_\gamma > 0.1$ γ continuum has allowed shape and intensity is 1.10 ±0.25 times theoretical value

B.Saraf, Phys. Rev. 102, 466 (1956).

Fe^{55} 26 29 Levels Fe^{54}(d,p) E_d = 6.54, 7.01 s; 10°,45°

g.s. Q = 7.073 **0.413** **0.932** **1.413**

Many levels observed between 1.30 and 7.60

A.Sperduto, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 4, 223 W4, 311 (1956).

Levels Mn^{55}(p,n) E_p = 1.7 to 3.9 thresh n, ~0°

0.925 *5* **1.327** *9* **2.165** *15*

R.A.Chapman, J.B.Marion, J.C.Slattery, Bull. Am. Phys. Soc. 1, No. 2, 95, N3 (1956); verbal report.

Fe^{56} 26 30 Levels $Fe^{(56)}(n,n')$ E_n = 6.5 ppl p-recoil

13†	**g.s.**
6†	**0.85**
3†	**2.09**

†σ(90°) in mb/sterad

J.B.Weddell, B.Jennings, Bull. Am. Phys. Soc. 1, No. 1, 55, R5 (1956); verbal report.

$Fe^{56}_{26\ 30}$

Levels $Fe^{(56)}(p,p')$ $E_p = 7.04$

0.85	sd; 30°, 130°
2.08	3.12
2.66	3.37
2.94	3.45
2.96	3.60

W. W. Buechner, A. Sperduto, Bull. Am. Phys. Soc. 1, No. 1, 39, JA3 (1956); verbal report.

Level $Fe^{(56)}(n,n')$ $E_n = 2.25, 2.45$
$Fe^{(56)}(n,n'\gamma)$ pulsed n's

$\sigma(90°)$*	Level	
85 3	0.86 3	$n,n'(\theta)$, $n,\gamma(\theta)$

Both angular distributions change with E_n
* For $E_n = 2.45$ σ units: mb/sterad

L. Cranberg, J. S. Levin, Phys. Rev. 103, 343 (1956); 100, 434 (1955); Bull. Am. Phys. Soc. 1, No. 1, 56 R10 (1956).

γ $Fe^{(56)}(n,n'\gamma)$ $E_n = 3.7$; scin

0.845 10	$\sigma(90°)$ = 135mb/sterad
1.23 1	
1.80 2	$\sigma(90°)$ = 24mb/sterad
2.10 3	

M. A. Rothman, H. S. Hans, C. E. Mandeville, Phys. Rev. 100, 83 (1955).

γ $Fe^{(56)}(n,n'\gamma)$ $E_n = 2.56$

$\sigma(95°)$	E_γ	
74 6	0.847 8	scin
3.7 4	1.241 12	σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

γ $Fe^{(56)}(n,n'\gamma)$ $E_n = 3.7$

$\sigma(100°)$	E_γ	
150 30	0.84 2	scin
26 5	1.25 2	σ units: mb/sterad

I. L. Morgan, Phys. Rev. 103, 1031 (1956).

$Fe^{57}_{26\ 31}$

Levels $Fe^{56}(d,p)$ $E_d = 6.54, 7.01$

g.s.	Q = 5.418	s; 10°, 45°
0.015		
0.135		
0.365		

Many levels observed between 0.36 and 6.5

A. Sperduto, W. W. Buechner, Bull. Am. Phys. Soc. 1, No. 4, 223 W4 (1956).

Level $Fe^{(57)}(p,p')$ $E_p = 7.04$

0.36	sd; 30°, 130°

W. W. Buechner, A. Sperduto, Bull. Am. Phys. Soc. 1, No. 1, 39, JA3 (1956); verbal report.

$Fe^{57}_{26\ 31}$

γ $Fe^{(57)}(n,n'\gamma)$ $E_n = 2.56$

$\sigma(95°)$	E_γ	
43 7	0.123 1	scin

σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

$Fe^{58}_{26\ 32}$

Levels $Fe^{57}(d,p)$ $E_d = 6.54, 7.01$

g.s.	Q = 7.808	s; 10°, 45°
0.799		
1.664		
2.125		

Many levels observed between 2.04 and 8.30

A. Sperduto, W. W. Buechner, Bull. Am. Phys. Soc. 1, No. 4, 223 W4, 311(1956).

$Fe^{59}_{26\ 33}$ 45^d

$\gamma(Co^{59})$

100†	1.100	s77 Cp
77†	1.278	

B. S. Dželepov, J. V. Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956); Doklady Akad. Nauk SSSR 86, 497 (1952).

$Fe^{59}_{26\ 33}$

Levels $Fe^{58}(d,p)$ $E_d = 6.54, 7.01$

g.s.	Q = 4.350	s; 10°, 45°
0.286		
0.473		
0.728		

Many levels observed between 0.73 and 6.20

A. Sperduto, W. W. Buechner, Bull. Am. Phys. Soc. 1, No. 4, 223 W4 (1956).

$Co^{56}_{27\ 29}$

ground state

J	4	para
$\lvert\mu\rvert$	3.848 15	

$|\mu(Co^{56})/\mu(Co^{59})| = 0.828\ 3$

J. M. Baker, B. Bleaney, P. M. Llewellyn, P. F. D. Shaw, Proc. Phys. Soc. 69A, 353 (1956).

ground state

J	4	para
$\lvert\mu\rvert$	3.855 7	

$|\mu(Co^{56})/\mu(Co^{59})| = 0.830\ 2$

R. V. Jones, W. Dobrowolski, C. D. Jeffries, Phys. Rev. 102, 738 (1956).

ground state

$|\mu|$ 2.6 2 from $|g| = 0.66\ 4$ $\gamma(\theta,T)$

R. C. Sapp, C. M. Schroeder, Bull. Am. Phys. Soc. 1, No. 2, 91, L1 (1956).

Co^{56} 27 29 77^d

β^+ **1.47** *3* sl

$\gamma(Fe^{56})$				
		15†	**2.02**	scin
100†	**0.845**		**2.06**	
10†	**1.03** ?	20†	**2.6**	
65†	**1.24**	2†	**2.99**	
20†	**1.75**	15†	**3.25**	

No 0.440, 0.977 β (< 2% of 1.47 β)

J.D.Kurbatov, H.J.Sathoff, Jr., K.Hisatake, M.Sakai, Bull. Am. Phys. Soc. 1, No. 4, 162 B5 (1956); verbal report.

$\gamma(Fe^{56})$				$Fe^{(56)}$(p,n)
				scin
100†	**0.85**			
76†	**1.20**	19.8†	**2.55**	
18†	**1.71**	1.6†	~**3.0**	
13†	**2.00**	14†	**3.25**	

$(0.85\gamma)/\beta^+ = 3.8$

C.S.Cook, F.M.Tomnovec, Bull. Am. Phys. Soc. 1, No. 1, 31, H8 (1956); verbal report

Co^{57} 27 30

ground state

J **7/2** para

$|\mu|$ **4.65** *5*

$|\mu(Co^{57})/\mu(Co^{59})| = 1.00$ *1*

J.M.Baker, B.Bleaney, P.M.Llewellyn, P.F.D. Shaw, Proc. Phys. Soc. 69A, 353 (1956); 66A, 305 (1953).

Co^{57} 27 30 270^d

E_ϵ **0.434** *30* x(continuum γ)

R.G.Jung, M.L.Pool, Bull. Am. Phys. Soc. 1, No. 4, 172 E11 (1956).

No β^+ (< 0.1%) d 36^hNi; scin

$(0.123\gamma)(0.014\gamma)$ delay = $101^{m\mu s}$ *5*

W.C.Middelkoop, A.Heyligers, L.H.Th.Rietjens, H.J.Van den Bold, P.M.Endt, Physica 21, 897 (1955).

$\gamma(Fe^{57})$				$Fe^{(56)}$(d,n) chem
		K/L	L/M	sd ce
1*	**0.01437** *1*	8.93	9.1	
49.6*	**0.12194** *3*	6.7		
	0.13631 *3*	8.2		

*Relative ce_K intensity

J.Bellicard, A.Moussa, Compt. rend. 241, 1202 (1955).

$\gamma(Fe^{57})$ $Fe^{(56)}$(18-Mev d,n) chem

No 0.029γ (< 3% of 0.0144γ) pc

No other γ with $0.009 < E_\gamma < 0.048$

M.A.Grace, G.A.Jones, J.O.Newton, Phil. Mag. 1, 363 (1956).

Co^{58} 27 31 72^d g.s.

$\gamma(Fe^{58})$ **0.805** $Ni^{(58)}$(fast n,p)

$\beta^+/0.805\gamma = 0.130$ *13* scin $\gamma^\pm/\gamma$

(K x ray)(0.805γ) pc, scin

No 0.50γ

M.A.Grace, G.A.Jones, J.O.Newton, Phil. Mag. 1, 363 (1956).

$\gamma(Fe^{58})$			$Mn^{55}(\alpha,n)$ chem
1.6†	**(0.81)***	E2/M1 = 4.8 *13*	$\gamma\gamma(\theta)$
100†	**0.814*** *10*		scin
0.5†	**1.62** *2*		

$(0.81\gamma)(0.814\gamma)(\theta)$ J = 2, 2, 0

*$\Delta E < 0.010$ No 0.50γ scin $\gamma\gamma$

H.Frauenfelder, N.Levine, A.Rossi, S.Singer, Phys. Rev. 103, 352 (1956); Bull. Am. Phys. Soc. 1, No. 4, 163 B6 (1956).

$\gamma(Fe^{58})$		$Ni^{(58)}$(pile n,p) chem
		scin
100†	**(0.81)**	
0.5†	**1.64** *4*	

B.L.Robinson, R.W.Fink, Bull. Am. Phys. Soc. 1, No. 1, 40, JA7 (1956); verbal report.

Co^{59} 27 32

Levels	$Co^{59}(n,n')$	$E_n = 2.45$
$\sigma(90°)$	Level	pulsed n's
38 *5*	**1.20** *3*	
34 *4*	**1.51** *2*	
12 *2*	**1.75** *2*	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Levels	$Co^{59}(n,n')$	$E_n = 4.3$; scin
	1.2	pulsed n's, 90°
	1.8	
	3.1	

R.V.Smith, Bull. Am. Phys. Soc. 1, No. 4, 175 F2 (1956); verbal report.

Co^{60} 27 33

ground state

J **5** Co^{59}(pile n,γ); para

$|\mu|$ **3.800** *7*

W.Dobrowolski, R.V.Jones, C.D.Jeffries, Phys. Rev. 101, 1001 (1956).

ground state

μ **positive**

From circular polarization of γ's from polarized Co^{60}

J.C.Wheatley, W.J.Huiskamp, A.N.Diddens, M.J.Steenland, H.A.Tolhoek, Physica 21, 841 (1955).

$Co^{60}_{27\ 33}$ 5.2^{y} g.s.

τ	5.20^{y} 3	(1)	
	5.25 4	(2)	
	5.27 7	(3)	

(1) E.E.Lockett, R.H.Thomas, Nucleonics 14, No. 11, 127 (1956); 11, No. 3, 14 (1953). Previous value of 4.95^{y} retracted.

(2) W.E.Perry, J.W.Dale, quoted by ref. 1.

(3) J.Tobailem, Ann. Phys. 10, 783 (1955); Compt. rend. 233, 1360 (1951).

β^-	0.01%*	1.478 6	$\Delta J = 3$, no shape	sl

*Assuming $\alpha = 1.32 \times 10^{-4}$ for 1.33 γ

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

$\gamma(Ni^{60})$		Co^{59}(pile n,γ)	chem
0.0012%	2.158		sd pe

J.L.Wolfson, Can. J. Phys. 33, 886 (1955).

$Co^{60}_{27\ 33}$

Capture γ's Co^{59}(th n,γ) scin Cp

0.237 5			
0.289 10		0.82 2	
0.43?		1.48 4	
0.65 2		1.82 4	

Study covered $E_\gamma = 0.1$ to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

$Co^{61}_{27\ 34}$ 1.7^{h}

τ	1.66^{h} 1		
β^- 95 ± 15%	1.220 40		scin

No γ with $0.40 < E_\gamma < 0.66$ ($< 0.5\%$)

R.H.Nussbaum, A.H.Wapstra, W.A.Bruil, M.J. Sterk, G.J.Nijgh, N.Grobben, Phys. Rev. 101, 905 (1956).

$Cu^{(65)}$(31.5-Mev γ,α) chem

τ	1.75^{h} 15		
$\gamma(Ni^{61})$	0.072 3		scin
$\gamma/\beta^- \sim 1$	No 0.50 γ ($< 5\%$)	No other γ	

P.Erdös, P.Jordan, D.Maeder, P.Stoll, Helv. Phys. Acta 28, 323A (1955).

Ni 28

Levels Ni(n,n') Ni(n,n'γ) $E_n = 2.45$ pulsed n's

$\sigma(90°)$	Level	
52 3	(1.33)	n,n'(θ), n,$\gamma(\theta)$
	(1.45)	σ units: mb/sterad

Angular distributions differ from those for similar reactions on Ti^{48} and Fe^{56}

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Ni 28

Levels Ni(n,n') $E_n = 4.3$; scin pulsed n's, 90°

1.4
2.1
2.5
2.9

R.V.Smith, Bull. Am. Phys. Soc. 1, No. 4, 175 F2 (1956); verbal report.

$Ni^{58}_{28\ 30}$

Levels $Ni^{(58)}$(p,p') $E_p = 4.580, 5.283$ scin

1.153* 10	2.275* 10
1.453 5	2.776* 10

*Assignment uncertain; calculation of energy based on A = 58

R.R.Spencer, G.C.Phillips, J.P.Schiffer, T.E. Young, Bull. Am. Phys. Soc. 1, No. 2, 95, M13 (1956); verbal report.

Level	$Ni^{(58)}$(p,p'γ)	$E_p = 2.5$ to 4.5	
γ	(1.45)	$\tau < 0.2^{\mu\mu s}$	scin

M.S.Moore, J.P.Schiffer, C.M.Class, Bull. Am. Phys. Soc. 1, No. 1, 39, JA4 (1956); verbal report.

Level $Ni^{(58)}$(n,n'γ) $E_n = 2.56$ scin

$\sigma(95°)$	Level	
45 4	1.453 14	σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

γ Ni^{58}(n,n'γ) $E_n = 4.4$ scin

33†	1.01 1
100†	1.46 2

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Ni^{59}_{28\ 31}$ 7.5×10^{4y}

$\tau_{\epsilon K}$	10.0×10^{4y} 25	Ni^{58}(pile n,γ)	
γ continuum has forbidden shape			scin

τ from specific K x ray activity

B.Saraf, Phys. Rev. 102, 466 (1956).

$Ni^{59}_{28\ 31}$

Levels Co^{59}(p,n)

0.345	1.79	thresh n
0.44	1.98	
1.22	2.15	
1.36	2.55	
1.58	2.65	

J.W.Butler, C.R.Gossett, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 4, 163 B8 (1956); verbal report.

Capture γ's $Ni^{(58)}$(th n,γ) scin Cp

8†	0.45 3		
3†	0.86 3	3†	2.06 3
2†	1.24 3	2†	2.68 3

Study covered $E_\gamma = 0.3$ to 3

†Photon /100 Ni captures, (±20%) ($\sigma_n = 4.5$)

(Max in Ni^{59}, Ni^{61}, Ni^{62}, Ni^{63}, Ni^{65} = 71, 15, 0.6, 13, 0.5†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

Ni^{60} 28 32

Levels $Ni^{(60)}(\gamma,\gamma)$ $5.2^{y}Co^{60}$ γ

g.s.	J = 0	scin $\gamma,\gamma(\theta)$
(1.33)	J = 2	

$\tau = 0.8^{\mu\mu s}$ 2 (half-life)

τ from Γ determined from self-absorption of resonance radiation

F.R.Metzger, Phys. Rev. 103, 983 (1956); Bull. Am. Phys. Soc. 1, No. 1, 40 JA6 (1956).

Levels $Ni^{(60)}(p,p')$ E_p = 4.580, 5.283

1.330 5	S77
2.156 10	

R.R.Spencer, G.C.Phillips, J.P.Schiffer, T.E. Young, Bull. Am. Phys. Soc. 1, No. 2, 95, M13 (1956); verbal report.

γ $Ni^{(60)}(n,n'\gamma)$ E_n = 2.56

$\sigma(95°)$	E_γ	
17 3	0.827 8	scin
55 6	1.329 10	
5 2	2.18 4	σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Resonances $Co^{59}(p,\gamma)$ E_p = 1.0 to 1.9

150 resonances observed for $E_\gamma \geq 4$

g.s. γ not observed (< 5% of γ to 1.33 level)

C.R.Gossett, J.W.Butler, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 4, 223 W5 (1956); verbal report.

Ni^{61} 28 33

Levels $Ni^{61}(\alpha,\alpha'\gamma)$ E_α = 4.4

γ 0.066	$\epsilon B(E2)$ = 0.00038	scin
0.282	= 0.00090	
0.657	= 0.0090	

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

Ni^{66} 28 38 55^{h}

τ	54.8^{h} 3	U(170-Mev p,f) chem
β^-	~0.15	a

A.Kjelberg, A.C.Pappas, Nuclear Phys. 1, 322 (1956).

τ	55.1^{h} 10	U(340-Mev p,f) chem
β^-	0.20 3 F-K linear	scin
No γ (< 0.1 of Cu^{66} 1.03γ)		scin

N.R.Johnson, R.K.Sheline, R.Wolfgang, Phys. Rev. 102, 831 (1956).

Cu 29

Levels Cu(n,n') E_n = 2.45 pulsed n's

$\sigma(90°)$	Level	
38 5	0.98 4	
32 6	1.46 3	
13 3	1.62 3	
9 2	1.74 2	
7 2	1.90 2	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Cu 29

Capture γ's Cu(th n,γ) scin Cp

0.202 10	
0.280 10	

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

γ Cu(n,n'γ) E_n = 2.56

$\sigma(95°)$	E_γ	$\sigma(95°)$	E_γ	
4 1	0.365 5	5 2	1.41 3	scin
6 1	0.651 6	2 1	1.47 3	
4 1	0.764 10	4 1	1.55 3	
29 4	0.958 10	2 1	1.88 4	
13 2	1.110 10	3 1	2.07 2	
9 1	1.325 10	< 0.3	2.52 3	

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

γ Cu(n,n'γ) E_n = 3.7

0.68 2	1.32 2	scin
0.97 2	1.90 2	
1.10 2	2.60 2	

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

Cu^{59} 29 30 81^{s}

τ	81^{s} 1		$Ni^{(58)}$(4-Mev d,n)	
β^+	100† 3.70 10			s
$\gamma(Ni^{59})$		10†	1.28 2	scin
	~3† 0.33 2	1.8†	1.67 4	
	11† 0.865 15	~0.3†	2.07 5	

$\gamma^{\pm}$(0.33, 0.865, 1.28γ)

No (0.865γ)(1.28γ)

F.W.Prosser, Jr., M.S.Moore, J.P.Schiffer, Bull. Am. Phys. Soc. 1, No. 4, 163 B7 (1956); verbal report.

β^+ 3.7 $Ni^{(58)}$(~4-Mev p,γ); s

M.S.Moore, J.P.Schiffer, C.M.Class, Bull. Am. Phys. Soc. 1, No. 1, 39, JA4 (1956); verbal report.

Ni^{58}(5.5-Mev d,n)

β^+	≥ 95%	GM
ϵ	≤ 5%	pc (K x ray)/β^+ ~ 0.015
No γ with 0.08 < E_γ < 0.50		(< 0.5% of β^+) scin

T.Yuasa, G.A.Renard, J. phys. radium, 16, 889 (1955).

$\gamma(Ni^{59})$	0.19 ?	Ni^{58}(1.84 - Mev p,γ)	
	0.35	1.31	scin
	0.87	1.80	

J.W.Butler, C.R.Gossett, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 4, 163 B8 (1956).

Cu^{59} 29 30

Resonance peaks	$Ni^{58}(p,\gamma)$	E_p = 0.6 to 1.8 scin, Cu^{59} $\gamma^{\pm}$
	0.855	
	0.947	
	1.009	1.375
	1.099	1.423
	1.226	1.521
	1.307	1.539
	1.315	1.581

C.R.Gossett, J.W.Butler, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 1, 40, JA5 (1956).

Cu^{61} 29 32 3.3 h

β^+	3†	0.560			sl
	5†	0.940			
	~2†	1.150			scin $\beta\gamma$
	51†	1.220 *15*			sl
$\gamma(Ni^{61})$	4†	0.070 *1*	11†	0.660 *10*	scin
	12†	0.280 *3*	1.5†	0.940 *50*	
	2.5†	0.380 *10*	1†	1.150 *50*	
	1.5†	0.580 *20*	5†	1.220 *50*	

R.H.Nussbaum, A.H.Wapstra, W.A.Bruil, M.J. Sterk, G.J.Nijgh, N.Grobben, Phys. Rev. 101, 905 (1956).

Cu^{61} 29 32

Resonance peaks	$Ni^{60}(p,\gamma)$		E_p = 0.6 to 1.8		scin
	0.725	1.247	1.431		
	0.895	1.313	1.451		
	1.029	1.319	1.461		
	1.066	1.323	1.465		
	1.078	1.331	1.483	1.567	
	1.132	1.343	1.491	1.578	
	1.167	1.347	1.515	1.589	
	1.197	1.371	1.519	1.600	
	1.209	1.381	1.529	1.607	
	1.239	1.415	1.539	1.620	

Γ< 1 kev for all peaks

C.R.Gossett, J.W.Butler, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 1, 40, JA5 (1956).

Cu^{63} 29 34

Levels	$Cu^{63}(n,n'\gamma)$				E_n = 4.4 scin
γ 40†	0.65 *1*	60†	1.34 *3*		
100†	0.97 *1*	20†	1.43 *5*		

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Cu^{(63)}(\gamma,n)$ E_γ = 17.57 to 17.83
Dip in activation curve found for $E_\gamma \sim 17.72$

J.G.Campbell, Australian J. Phys. 8, 449 (1955).

Cu^{64} 29 35 13 h

$(1.35\gamma)/\gamma^{\pm}$ = 0.0207 sπ Cp

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956); Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 511 (1953).

Cu^{65} 29 36

Level	$Cu^{65}(n,n'\gamma)$		E_n = 4.4 scin
γ 90†	1.12 *2*		

†Photons/100 0.97γ's from $Cu^{63}(n,n'\gamma)$

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

Cu^{66} 29 37 5.1 m

		$^{55h}Ni^{66}$ source
β^-	1.64 *3*	scin
	2.63 *3*	
$\gamma(Zn^{66})$	1.03 *2*	scin

N.R.Johnson, R.K.Sheline, R.Wolfgang, Phys. Rev. 102, 831 (1956).

Zn 30

Level	Zn(n,n')		E_n = 2.45 pulsed n's
$\sigma(90°)$	Level		σ units: mb/sterad
62 *4*	1.08 *4*		

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Capture γ's	Zn(th n,γ)			scin Cp
11†	1.07 *3*	12†	1.77 *3*	
7†	1.26 *3*	10†	2.02 *3*	

Study covered E_γ = 0.3 to 3
†Photons/100 Zn captures ±20% (σ_a = 1.09)
(Max in Zn^{65}, Zn^{67} + Zn^{68}, Zn^{69}, Zn^{71} = 22, 62, 16, 0.05†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

Zn^{63} 30 33

Level	$Cu^{63}(p,n)$	E_p = 4.2 to 5.3; VdG thresh n, ~0°
g.s.	Q = -4.149 *4*	
0.191 *11*		
0.642 *11*		
1.043 *15*		

Graph of $\sigma(\sim 0°)$ given for n yield

R.M.Brugger, T.W.Bonner, J.B.Marion, Phys. Rev. 100, 84 (1955).

Zn^{64} 30 34

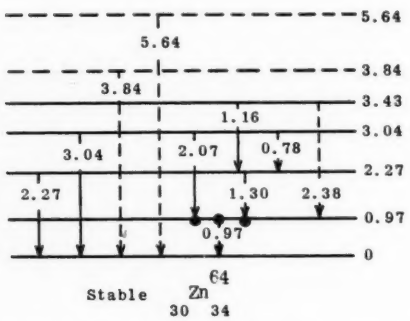
Capture γ's	$Cu^{63}(p,\gamma)$				E_p = 2 scin
32†	0.78 *2*	40†	2.27 *5*		
100†	0.97 *1*		2.38? *5*		
17†	1.16 *3*		3.04 *5*		
29†	1.30 *3*		3.84? *5*		
41†	2.07 *4*		5.64? *5*		

Other γ's with $5.6 < E_\gamma < 10$
(0.97γ)(0.78, 1.16, 1.30, 2.07, 2.38γ)*
No (0.97γ)(2.27γ)*
*With E_p = 2.5

Continued

Zn^{64} 30 34

Continued



C.E.Weller, J.C.Grosskreutz, Phys. Rev. 102, 1149 (1956); 99, 655A (1955).

Zn^{65} 30 35 245^{d}

β^+	**0.324** *4*	sl

$\epsilon_K/\beta^+ = 47 \pm 5$ from (K x ray)/$\beta^+ = 20 \pm 2$ and using $\omega_k = 0.42$ pc with magnetic field

P.Avignon, Ann. Phys. 1, 10 (1956); Compt. rend. 237, 157 (1953).

$Zn^{(64)}$(slow n,γ)

$\gamma(Cu^{65})$	**1.112** *3*	scin
$1.112\gamma/\beta^+ = 47$		$\gamma/\gamma^{\pm}$

K.E.Johansson, Arkiv Fysik 10, 247 (1956).

Zn^{65} 30 35

Levels $Cu^{(65)}$(p,n) $E_p \sim 2.9$

100+	g.s.	Q = **-2.131** *5*
100+	**0.118** *8*	

0.052, 0.092 levels not observed ($< \sim 20$†)
n resonances in S used to select E_n

J.B.Marion, R.A.Chapman, Phys. Rev. 100, 1795A (1955); 101, 283 (1956).

Level Cu^{65}(p,n) E_p = 2.1 to 4.1; VdG

Level	thresh n, $\sim 0°$
g.s.	Q = **-2.136** *4*
0.78 *3*	
1.26 *3*	
1.93 *2*	

No indication of 0.052, 0.092, 0.114 levels
Graph of $\sigma(\sim 0°)$ given for n yield

R.M.Brugger, T.W.Bonner, J.B.Marion, Phys. Rev. 100, 84 (1955).

Zn^{66} 30 36

Capture γ's Cu^{65}(p,γ) E_p = 1.9 scin

0.83 *2*	
1.04 *1*	**2.72** *4*
1.37 *2*	**3.39**?
1.71*	**3.76** *5*
1.78? *3*	**4.12** *5*
2.17 *4*	**4.33** *5*
2.41 *4*	**4.52**? *5*
2.48*	$4.5 < E_\gamma < 10$

(1.04 γ)(0.83, 1.37, 1.71, 2.17, 2.48, 2.72 γ)
*Observed only in coincidence spectra

C.E.Weller, J.C.Grosskreutz, Phys. Rev. 102, 1149 (1956); 99, 655A (1955).

Zn^{67} 30 37

Level $Zn^{(67)}(\gamma,\gamma)$ $E_\gamma \leq 22$; scin

γ	**0.090** *5* $\gamma\gamma$ delay = $8.8^{\mu s}$ *10*

S.H.Vegors, Jr., P.Axel, Phys. Rev. 101, 1067 (1956).

Ga^{66} 31 35 9.4^{h}

$\gamma(Zn^{66})$ $Zn^{(66)}$(22-Mev d,2n)

1.89	**3.35**	scin pr
2.14	**3.76**	
2.38	**4.14**	
2.73	**4.27**	
3.23	**4.78**	

D.E.Alburger, B.J.Toppel, Phys. Rev. 100, 1357 (1955).

Ga^{67} 31 36

Levels Zn^{67}(p,n) E_p = 1.8 to 3.9

g.s.	thresh n, $\sim 0°$
0.357 *7*	**1.235** *15*
0.857 *20*	**1.544** *20*

R.A.Chapman, J.B.Marion, J.C.Slattery, Bull. Am. Phys. Soc. 1, No. 2, 95, N3 (1956); verbal report.

Ga^{68} 31 37 68^{m}

β^+	4.1†	**(0.92)**	275^{d} Ge^{68} source; sl
	100†	**1.94** *5*	
$\gamma(Zn^{68})$	7†	**1.02** *2*	scin

$\beta^+/1.02\gamma = 14.4$ *17* (if no Ge^{68} β^+) scin $\gamma^{\pm}/\gamma$

S.Crasemann, D.E.Rehfuss, H.T.Easterday, Phys. Rev. 102, 1344; Bull. Am. Phys. Soc. 1, No. 5, 253 F6 (1956).

Ga^{68} 31 37

Level $Zn^{(68)}$(p,n) E_p = 2.7 to 4.3

Level	thresh n, $\sim 0°$
g.s.	Q = **-3.694** *6*
0.170 *9*	

R.M.Brugger, T.W.Bonner, J.B.Marion, Phys. Rev. 100, 84 (1955).

Levels Zn^{68}(p,n) E_p = 3.6 to 5.3

g.s.	thresh n, $\sim 0°$
0.189 *8*	
0.344 *9*	**1.112** *23*
0.578 *12*	**1.234** *23*
0.854 *17*	**1.586** *23*

R.A.Chapman, J.R.Marion, J.C.Slattery, Bull. Am. Phys. Soc. 1, No. 2, 95, N3 (1956); verbal report.

Ga^{69} 31 38

Level $Ga^{69}(\alpha,\alpha'\gamma)$ E_α = 4.8

γ	**0.324**	$\epsilon B(E2) = 0.0079$ scin

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

$Ga^{70}_{31\ 39}$ Resonances $Ga^{69}(n)$ chopper

$\sigma_o(10^3 b)$	$E_o(ev)$	$\Gamma(ev)$	$\Gamma_n(ev)$
1.8 4	**112**	0.36 2	0.06
1.5	**340**	0.49	0.19
1.5 2	**710**	1.6 2	1.3

Assumed $\Gamma_\gamma = 0.3$ ev and $g = 1/2$

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Ga^{71}_{31\ 40}$ Level $Ga^{71}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.4$

γ **0.513** $\epsilon B(E2) = 0.012$ scin

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

$Ga^{72}_{31\ 41}$ ^{14h} $\gamma(Ge^{72})$ $Ga^{(71)}(n,\gamma)$ scin

$\leq$0.8†	**0.32** *1*	5†	**1.24** 2	
$\leq$1.1†	**0.39** *1*	$\leq$1.3†	**1.32** *3*	
$\leq$1.8†	**0.44** *1*	2.8†	**1.46** *1*	
3.7†	**0.51** *1*	7.8†	**1.59** 2	
6.5†	**0.60**	$\leq$2†	**1.79** *3*	
22†	**0.63**	8.4†	**1.88** *1*	
2†	**0.72** 2	41†	**(2.20)**	
100†	**(0.835)**	$\leq$2†	**2.40** 2	
7†	**0.91** 2	30†	**(2.50)***	
9†	**1.04** *1*	0.6†	**2.82** *1*	

γ's in γ(0.68 ce) delay spectrum

0.03†	**0.115** *4*		
0.05†	**0.62** 2	0.20†	**1.71** 2
0.04†	**0.73** *3*	0.07†	**1.82** *4*
0.16†	**0.95** 2	0.07†	**2.15** *4*
0.04†	**1.34** *6*	0.08†	**2.69** *3*

Table of $\beta\gamma$ given showing additional 1.68γ
(0.84 γ)(0.63, 0.77, 0.89, 1.05, 1.30, 1.62, 1.87, 2.20, 2.50 γ)
(0.63 γ)(0.62, 0.84, 1.05, 1.30, 1.48, 1.64, 1.79, 1.90 γ)
(1.47 γ)(1.90, 1.59, 1.30, 1.05 γ)
Decay scheme proposed with levels in Ge^{72}:
g.s. (0^+), 0.69 ($\tau = 0.3^{\mu s}$, 0^+), 0.84 (2^+), 1.46 (2^+), 1.73 ($2^+,3^+$), 2.06 (2^+), 2.39 ($1^+,2^+$), 2.51 (2^+), 2.82 ($1^+,2^+$), 3.04 ($2^-,3^-$), 3.32 ($2^-,3^-$), 3.34 (2^-)
No 0.69 photon ($\leq$2†)
*Unresolved 2.508γ and 2.491γ

J.J.Kraushaar, E.Brun, W.E.Meyerhof, Phys. Rev. 101, 139 (1956).

$Ga^{72}_{31\ 41}$ Resonances $Ga^{71}(n)$ chopper

$\sigma_o(10^3 b)$	$E_o(ev)$	$\Gamma(ev)$	$\Gamma_n(ev)$
2.7 *10*	**95**	0.37 *4*	0.07
4.3 *1*	**290**	7.7 *5*	7.4
3.1 *1*	**380**	3.6 *5*	3.3
0.7 2	**770**	0.52 *10*	0.22

Assumed $\Gamma_\gamma = 0.3$ ev and $g = 1/2$

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Ga^{74}_{31\ 43}$ $^{\sim 8^m}$ τ $\sim 8^m$ $Ge^{(74)}$(fast n,p)

$\gamma(Ge^{74})$ **0.58** scin
2.3
2.6

H.Morinaga, Phys. Rev. 103, 504 (1956).

$Ge^{?}_{32}$ $^{14^d}$

τ	14^d	Ge(pile n) chem
x	**Ga K x ray**	crit a
E_{max}	**0.164**	γ continuum, scin
No γ observed		scin

Half-life from decay of γ continuum

M.Langevin, Ann. Phys. 1, 57 (1956); Compt. rend. 238, 2518 (1954).

$Ge^{68}_{32\ 36}$ $^{275^d}$ τ 275^d *20* $Zn^{(66)}$(37-Mev α,2n) chem

No β^+ with $E_\beta > 0.3$ sl

B.Crasemann, D.E.Rehfuss, H.T.Easterday, Phys. Rev. 102, 134; Bull. Am. Phys. Soc. 1, No. 5, 253 F6 (1956).

$Ge^{71}_{32\ 39}$ $^{11^d}$ $Ge^{(70)}$(pile n,γ) chem

E_ϵ **0.237** *5*	γ continuum, scin
$(e_{AL} + L\ x\ ray)/e_{AK} = 1.26$	pc
$\epsilon_L/\epsilon_K = 0.25$ 2 ($\omega_k = 0.473$*)	

Theoretical value for ϵ_L/ϵ_K is 0.11

M.Langevin, Ann. Phys. 1, 57 (1956); Compt. rend. 238, 2518; 239, 1625 (1954); *J. Laberrigue-Frolow, P.Radvanyi, M.Langevin, J. phys. radium 17, 530 (1956).

$Ge^{72}_{32\ 40}$ Level $Ge^{(72)}(\gamma,\gamma)$ As^{72} recoil

(0.835)	$\tau = 3.2^{\mu\mu s}$ *8*		σ
	J = 2		$\gamma,\gamma(\theta)$

F.R.Metzger, Phys. Rev. 101, 286 (1956).

$Ge^{74}_{32\ 42}$ Level $Ge^{(74)}(\gamma,\gamma)$ As^{74} recoil

(0.596)	$\tau = 13^{\mu\mu s}$ 2		σ
	J = 2		$\gamma,\gamma(\theta)$

F.R.Metzger, Phys. Rev. 101, 286 (1956).

$As^{72}_{33\ 39}$ ^{26h} $\gamma(Ge^{72})$ $Ga^{(69)}$(17-Mev α,n) chem

10.3†	**0.63** *1*			scin $\gamma,\gamma\gamma,\gamma$ce
	0.73* 2	2.6†	**2.08** 2	
100†	**(0.835)**	3.7†	**2.20** 2	
	0.90* 2		**2.24***	
2.7†	**1.05** *1*	1.2†	**2.32** *3*	
2.2†	**1.25** 2	1.7†	**2.51** 2	
1.4†	**1.37** 2	0.9†	**2.63** ?	
4.0†	**1.46** *1*	0.7†	**2.76** ?	
1.1†	**1.68** 2	1.5†	**2.91** *3*	
	1.75*		**3.0***	
1.0†	**1.92** *3*	0.3†	**3.74** *5*	

Continued

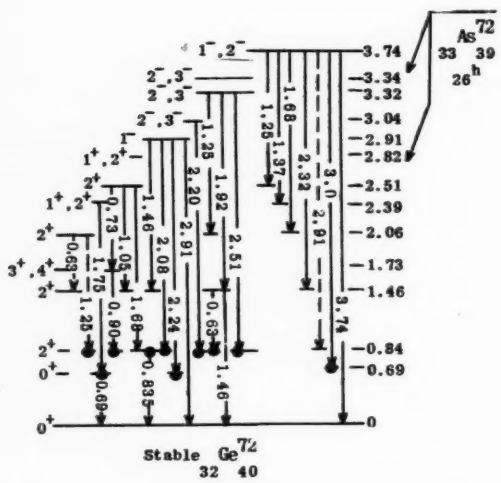
As^{72} 33 39 26^h — Continued

$(0.835\gamma)(0.63,\ 0.73,\ 0.90,\ 1.05,\ 1.25,\ 1.37,\ 1.92,\ \sim 2.1,\ 2.32,\ 2.51\gamma)$

$(\gamma^{\pm}?,\ 1.75,\ 2.24,\ 3.0\gamma)(ce\ 0.69\gamma)$

$\beta^-/0.835\gamma = 0.96$ *10* scin $\gamma^{\pm}/\gamma$

[c] Observed in coincidence spectrum only 3.34 and 2.82 levels known from decay of $14^h Ga^{72}$ were not observed



E.Brun, J.J.Kraushaar, W.E.Meyerhof, Phys. Rev. 102, 808 (1956); Phys. Rev. 100, 1795A (1955).

As^{75} 33 42

	ground state	
μ	+1.45 *15*	S
q	+0.32 *5*	

K.Murakawa, S.Suwa, Rept. Inst. Sci. Technol, Univ. of Tokyo 6, 209 (1952).

$As^{75}(n,n')$ $E_n = 2.45$ pulsed n's

Levels $\sigma(90°)$	Level	
27 *6*	0.78 *4*	
47 *8*	1.25 *3*	
21 *3*	1.63 *2*	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

γ $As^{75}(\gamma,\gamma')$ $E_\gamma \leq 22$; scin

0.283 *15* $\gamma\gamma$ delay = 12^{ns} *3*

S.H.Vegors,Jr., P.Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

γ $As^{75}(n,n'\gamma)$ $E_n = 1.35$; scin

(0.280) n,γ delay = 21^{ns} *2* pulsed neutrons

E.C.Campbell, P.H.Stelson, ORNL-2076 p. 32 (1956).

As^{75} 33 42 γ $As^{75}(n,n'\gamma)$ $E_n = 3.7$; scin

0.815 *10*

1.02 *1*

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 100, 83 (1955).

As^{76} 33 43 26.5^h τ 26.5^h *2* differential ic

B.S.Dzhelepov, O.E.Kraft, Vestnik-Leningrad Univ., Ser. Mat. Fiz. Khim. No. 8, 97 (1955); Chem. Abstr. 50, No. 12675e (1956).

β^-	1.77 *2*	F-K linear*	sl $\beta,\beta\gamma$
	2.42 *1*	F-K linear*	
	2.97 *1*	$\Delta J = 2$, yes shape*	sl

*$E_\beta \geq 1$

A.V.Pohm, R.C.Waddell, E.N.Jensen, Phys. Rev. 101, 1315 (1956).

$\gamma(Se^{76})$ 0.5605 *3* cryst

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

$(0.64\gamma)(0.55\gamma)$ delay = $23^{\mu\mu s}$ *15* scin

C.F.Coleman, Phil. Mag. 46, 1135 (1955).

As^{85} 33 52 Assignment here of 0.43^s delayed-n activity accounts for fission yields in Kr region of U^{233}, U^{235}, U^{238}, Pu^{239}

[$E_\beta > 9$, $B_n(Se^{75}) \sim 5$ from systematics]

W.H.Fleming, quoted by R.K.Wanless, H.G Thode, Can. J. Phys. 33, 541 (1955).

$Se(n,n')$ $E_n = 2.45$ pulsed n's

Levels $\sigma(90°)$	Level	
64 *8*	0.66 *5*	
43 *5*	1.50 *3*	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

γ $Se(n,n'\gamma)$ $E_n = 3.7$; scin

1.05 *2*

1.50 *3*

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 100, 83 (1955).

$Se(n)$ $E_n = 1$ to 2000 ev chopper

Resonance peaks	E_o(ev)	$\sigma_o \Gamma^2$
	27.1	53
	211	1410
	270	3520
	383	920

L.M.Bollinger, D.A.Dahlberg, R.R.Palmer, G.E.Thomas, Phys. Rev. 100, 126 (1955).

Se 34

Resonance peaks — Se(n) — chopper

E_o(ev)	A*	E_o(ev)	A*
212	78	973	78
272		1970	81
383		3110	
673	78	4120	81
884		5340	81

*Product A assignment from enriched samples

J.M.LeBlanc, L.M.Bollinger, R.E.Coté, Phys. Rev. 100, 1248A (1955); verbal report.

Resonance peaks — Se(n) — E_n = 1 to 80 kev, Li(p,n)

3 kev $l_n = 0$

7 $l_n = 0$

Assigned to Se^{81}

Graph given showing 6 more peaks

H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williamson, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956); 94, 774A (1954).

Se^{73} 34 39 — 7.1^h

Ge(70)(28-Mev α,n) chem

β^+ 100† **1.29** *1* sl

≤1†$ **1.65** *2*

$\gamma(As^{73})$

		α_K*	K/LM	
126†	**0.0658** *1*	0.22	10.2	M1 scin
154†	**0.359** *1*	0.011	8	M2

$\gamma^{\pm}$ (0.066, 0.359 γ) delay = $6.0^{\mu s}$ *2*

(0.066 γ)(0.359 γ) $\gamma^{\pm}$(0.066 γ) delay < $5^{m\mu s}$

No other γ (< 2†)

$From $6^{\mu s}$ delay for ≥ 99% of $\gamma^{\pm}$(0.066 γ)

*From ce_K per β^+ and theoretical ϵ/β^+ ratio

R.W.Hayward, D.D.Hoppes, Phys. Rev. 101, 93 (1956); 98,1172A (1955).

Se^{75} 34 41 — 127^d

(0.124 γ)(0.281 γ)(θ) $\eta(\pi) = -0.51$ *3* scin

(0.138 γ)(0.269 γ)(θ) $\eta(\pi) = +0.024$ *45*

Agree with J = 1/2 to 5/2, 3/2(5/2), 1/2(3/2), 3/2 for As^{75} levels at 0.405, 0.281, 0.269, g.s.

Probably no $P_4(\cos\theta)$ terms

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

(0.097 γ)(0.280 γ) delay = 18.0^{ms} *15* scin

A.W.Schardt, Bull. Am. Phys. Soc. 1, No. 2, 85, D1 (1955).

Se^{78} 34 44

Resonance peaks — Se^{77}(n) — chopper

E_o(ev)	E_o(ev)
212	973
673	

J.M.LeBlanc, L.M.Bollinger, R.E.Coté, Phys. Rev. 100, 1248A (1955); verbal report.

Se^{81} 34 47

Resonance peaks — Se^{80}(n) — chopper

E_o(ev)	E_o(ev)
1970	5340
4120	

J.M.LeBlanc, L.M.Bollinger, R.E.Coté, Phys. Rev. 100, 1248A (1955); verbal report.

Br ? 35

γ — Br(γ,?γ) — $E_\gamma \leq 22$; scin

0.155 *10** γγ delay = $130^{\mu s}$ *20*

0.270 *15* γγ delay = $32^{\mu s}$ *10*

*Threshold = 9.85 *25*

S.H.Vegors,Jr., R.B.Duffield, Bull. Am. Phys. Soc. 1, No. 4, 206 R1 (1956); verbal report.

Br^{79} 35 44

Level — $Br^{79}(\alpha,\alpha'\gamma)$ — E_α = 3.6; scin

γ **0.219** $\epsilon B(E2) = 0.025$

No other γ

E.A.Wolicki, L.W.Fagg, E.H.Geer, Phys. Rev. 100, 1265A (1955); verbal report.

Br^{80} 35 45 — 18^m g.s.

Br^{79}(pile n,γ)

β^+ 2.8† **0.868** *7* sπ

β^- ~15† **1.38** *8* sl βγ

~85† **1.99** *1* sl

$\gamma(Kr^{80})$ **0.620** scin

(1.38β)(0.620 γ) sl

No other γ (<4†)

J.Laberrigue-Prolow, Ann. Phys. 1, 152 (1956); Compt. rend. 232, 1201 (1951); 234, 2599 (1952); 236, 1246 (1953); 238, 677 (1954); J. phys. radium 15, 584 (1954).

Br^{80} 35 45 — 4.5^h

$Br^{(79)}$(slow n,γ)

(ce_K 0.048 γ)(ce_K 0.036 γ)(θ) favors M3 for 0.048γ and E1 for 0.036γ scin

E.Breitenberger, Proc. Phys. Soc. 69A, 453 (1956).

Br^{80} 35 45

Resonance peaks — Br^{79}(n) — chopper

σ_o	E_o(ev)	Γ(ev)	Γ_γ(ev)
3700	35.4	0.44	0.395
1670	54.3	0.375	0.347
1320	188	0.450	0.364
	204*		
	238		
	293*		
	318		
	392*		
	467*		

*May be in Br^{82}

J.M.LeBlanc, L.M.Bollinger, R.E.Coté, Phys. Rev. 100, 1248A (1955); verbal report.

Br^{81} 35 46

Level — $Br^{81}(\alpha,\alpha'\gamma)$ — E_α = 3.6; scin

γ **0.278** $\epsilon B(E2) = 0.031$

E.A.Wolicki, L.W.Fagg, E.H.Geer, Phys. Rev. 100, 1265A (1955); verbal report.

$Br^{82}_{35\ 47}$ 36^h

β^-	100%	**0.435**			sl
$\gamma(Kr^{82})$	70†	**0.556**	30†	**0.825**	sl ce,
	40†	**0.615**	45†	**1.042**	scin
	30†	**0.698**	28†	**1.313**	
	100†	**0.777**	19†	**1.478**	

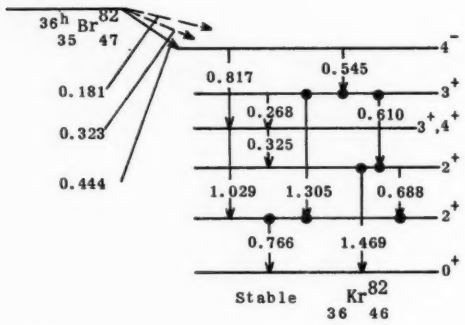
No β with $E_\beta > 0.435$ ($< 0.6\%$)

N.Benczer, C.S.Wu, Bull. Am. Phys. Soc. 1, No. 1, 41 K1 (1956); verbal report.

$Br^{(81)}$(pile n,γ)

β^-	**0.444** 1	F-K linear		sl
$\gamma(Kr^{82})$ 102†	**0.545** 2	$\alpha_K = 0.00068^*10$	scin γ,	
		M2/E1 = 0.0237$^\$$		sl ce
50†	**0.610** 2	$\alpha_K = 0.0016^*2$		
		E2/M1 = 5.29$^\$$		
37†	**0.688** 2	$\alpha_K = 0.0011^*2$		
100†	**0.766** 3	$\alpha_K = 0.0010$ 2		
30†	**0.817** 7	$\alpha_K = 0.00032^*9$		
36†	**1.029** 5	$\alpha_K = 0.00036^*3$		
36†	**1.305** 5	$\alpha_K = 0.00018^*2$		
		E2/M1 = 15.8$^\$$		
18†	**1.469** 7	$\alpha_K = 0.00018^*3$		
	1.85 ?			scin
	2.1 ?			

(1.469 γ)(0.545, 0.610γ) scin
(0.766 γ)(1.305γ) No (0.766 γ)(1.469γ)
(0.766 γ)(ce 0.688γ) scin γ, sl ce
($E_\gamma \geq 1.305$)(ce 0.545, 0.610, 0.766γ)
No ($E_\gamma \geq 1.029$)(ce 0.688γ)
(0.610 γ)(1.469 γ)(θ) scin
(1.305 γ)(0.766 γ)(θ) (0.545 γ)(0.610 γ)(θ)
(0.545 γ)(1.305 γ)(θ) (0.545 γ)(1.469 γ)(θ)
$\gamma\gamma(\theta)$ consistent with proposed decay scheme
*$\alpha_K = 0.0008$ (theoretical E2) used for 0.766γ
$^\$$From $\gamma\gamma(\theta)$



R.C.Waddell, E.N.Jensen, Phys. Rev. 102, 816 (1956).

$Br^{82}_{35\ 47}$

Resonance peaks

Br^{81}(n) E_o(ev)	chopper E_o(ev)
101	**293***
135	**392***
204*	**467***

Other peaks at 553, 669, 1540 ev
*May be in Br^{80}

J.M.LeBlanc, L.M.Bollinger, R.E.Cote, Phys. Rev. 100, 1248A (1955); verbal report.

Kr 36

Relative isotopic abundances ms
No Kr^{76} ($< 4 \times 10^{-6}\%$) No Kr^{77} ($< 3 \times 10^{-5}\%$)
No Kr^{79} ($< 2 \times 10^{-5}\%$) No Kr^{81},Kr^{87} ($< 10^{-5}\%$)
No Kr^{85} ($< 5 \times 10^{-5}\%$) No Kr^{88} ($< 10^{-6}\%$)
No Kr^{89} ($< 2 \times 10^{-6}\%$)

D.C.Hess, ANL-5420 (1956).

$Kr^{79}_{36\ 43}$

Levels	Kr^{78}(d,p)		$E_d = 4$
	g.s.	Q = 5.9	ppl 90°
	0.4		

N.C.Blais, W.W.Watson, Bull. Am. Phys. Soc. 1, No. 6, 281 B9 (1956).

$Kr^{80}_{36\ 44}$

Level	$Kr^{(80)}$($\alpha,\alpha'\gamma$)	$E_\alpha = 6.6$
γ	**0.610**	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Kr^{81}_{36\ 45}$

Levels	Kr^{80}(d,p)		$E_d = 4$
	g.s.	Q = 5.1	ppl 90°
	0.5		

N.C.Blais, W.W.Watson, Bull. Am. Phys. Soc. 1, No. 6, 281 B9 (1956).

$Kr^{82}_{36\ 46}$

Level	$Kr^{(82)}$($\alpha,\alpha'\gamma$)	$E_\alpha = 6.6$
γ	**0.775**	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Kr^{83}_{36\ 47}$

	ground state	
J	9/2	enriched Kr^{83} S
q	+0.22 2	

E.Rasmussen, V.Middelboe, Kgl. Danske Videnskab. Selskab Mat.-fys. Medd. 30, No. 13 (1955).

Level	$Kr^{(83)}$($\alpha,\alpha'\gamma$)	$E_\alpha = 6.6$
γ	**0.457**	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Kr^{84}_{36\ 48}$

Level	$Kr^{(84)}$($\alpha,\alpha'\gamma$)	$E_\alpha = 6.6$
γ	**0.880**	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Kr^{85}_{36\ 49}$ 10^y g.s.

Charges 1 to 10 (av. = 1.51) found on recoils
Charge distribution given s Rb^{85} recoil

A.H.Snell, F.Pleasonton, Bull. Am. Phys. Soc. 1, No. 5, 263 E7 (1956); No. 1, 42, K6 (1956).

Kr^{85} 36 49 4.4^h — IT 22% — U^{235}(n,f) ms

From 10.3^y Kr^{85}/Rb^{85} yield

Authors conclude U^{235} fission yield is a smooth function of A in this region

A.T.Blades, H.G.Thode, Z. Naturf. 10a, 838 (1955).

$Rb^{\leq 80}$ 37 — τ 8^d — Ag(480-Mev p) chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

Rb^{81} 37 44

ground state

J 3/2 M

J.P.Hobson, J.C.Hubbs, W.A.Nierenberg, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 101 (1956); Bull. Am. Phys. Soc. 1, No. 5 252 F4 (1956).

30^m level

J 9/2 M

J.C.Hubbs, W.A.Nierenberg, H.A.Shugart, H.B. Silsbee, Phys. Rev, 104, 757 (1956); Bull. Am. Phys. Soc. 1, No. 5, 253 F5 (1956).

Rb^{82} 37 45

0.24 level

J 5 M

J.P.Hobson, J.C.Hubbs, W.A.Nierenberg, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 101 (1956); Bull. Am. Phys. Soc. 1, No. 5 252 F4 (1956).

Rb^{82} 37 45 1.3^m g.s. — τ 1.1^m 2 — Ag(480-Mev p) chem

β^+ 3.5

d 25^{d}Sr chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

Rb^{82} 37 45 6.3^h — β^+ 100% 0.783 — sl

γ's same as in Br^{82}, q.v.

N.Benczer, C.S.Wu, Bull. Am. Phys. Soc. 1, No. 1, 41 K1 (1956); verbal report.

Rb^{83} 37 46

ground state

J 5/2 M

J.P.Hobson, J.C.Hubbs, W.A.Nierenberg, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 101 (1956); Bull. Am. Phys. Soc. 1, No. 5 252 F4 (1956).

Rb^{83} 37 46 83^d — τ 100^d — Ag(480-Mev p) chem

d 38^{h}Sr chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

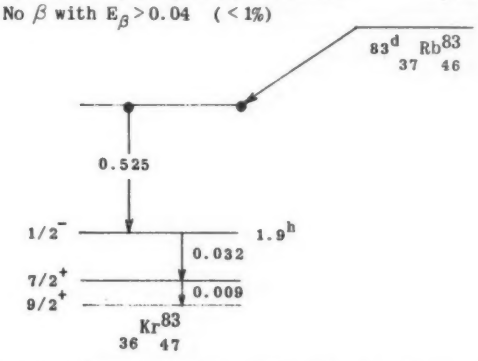
$Br^{(81)}$(14-Mev α,2n) chem

$\gamma(Kr^{83})$ 0.525 7 scin

(K x ray)(0.525 γ)

ϵ(0.566 level)/ϵ(total) = 1.0 ±0.1 xγ/x

No β with $E_\beta > 0.04$ (< 1%)



M.L.Perlman, J.P.Welker, Phys. Rev. 100, 81 (1955).

Rb^{84} 37 47

ground state

J 2 M

J.P.Hobson, J.C.Hubbs, W.A.Nierenberg, H.B. Silsbee, R.J. Sunderland, Phys. Rev. 104, 101 (1956); Bull. Am. Phys. Soc. 1, No. 5, 252 F4 (1956).

Rb^{84} 37 47 34^d g.s. — τ 33.0^d 2 — $Br^{(81)}$(14-Mev α,n) chem

β^+ 15† 0.81 5 scin

15† 1.70 7

β^- 3.7†* 0.910* sl

$\gamma(Kr^{84})$

100† 0.89 2 scin

1.4† 1.91 5

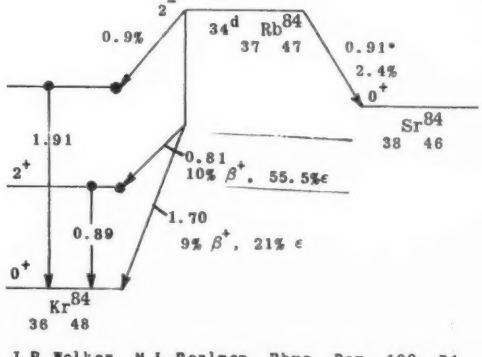
No 1.02γ (< 0.5†) (0.89γ)γ

(~0.8β)γ a$\beta\gamma$

(K x ray)(0.89, 1.91γ) $\gamma^{\pm}$(0.89γ)

(0.81β^+)/(0.89γ) = 0.150 11 $\gamma^{\pm}\gamma/\gamma$

ϵ(0.89 level)/ϵ(total) = 0.71 3 xγ/x



J.P.Welker, M.L.Perlman, Phys. Rev. 100, 74 (1955); *C.S.Wu, N.Benczer, ibid.

Rb^{85} 37 48

ground state

q +0.27 2 M

B.Senitzky, I.I.Rabi, Phys. Rev. 103, 315 (1956); 98, 1537A (1955).

Level $Rb^{85}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.4$

γ 0.148 $\epsilon B(E2) = 0.0032$ scin

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

Rb^{86} 37 49 19^d g.s.

β^- 1 to 5^+ 0.230 20 s

14^+ 0.711 15

86^+ 1.795 15 $\Delta J = 2$, yes shape

$\gamma(Sr^{86})$ 0.527 3 s ce

1.081 4

A.G.Dmitriev, P.P.Zarubin, Izvest. Akad. Nauk Ser. Fiz. SSSR 18, 580 (1954).

$Rb^{(85)}$(pile n,γ) chem

β^- 15% 0.720 30 sl β(1.08γ)

85% 1.760 10 $\Delta J = 2$, yes shape sl

J.Laberrigue-Frolow, Ann. Phys. 1, 152 (1956).

Rb^{87} 37 50

ground state

q +0.14 6 S

H.Kopfermann, A.Steudel, J.O.Trier, Z. Phys. 144, 9 (1956).

ground state

q +0.13 1 M

B.Senitzky, I.I.Rabi, Phys. Rev. 103, 315 (1956).

Rb^{87} 37 50 $\sim 5 \times 10^{10y}$

τ $4.3^{+3}_{-2} \times 10^{10y}$* specific activity

No γ, no ce 2π pc $\beta\gamma,\beta$(ce)

*Assuming 27.85% Rb^{87} in natural Rb

I.Geese-Bähnisch, Z. Phys. 142, 565 (1955); I.Geese-Bähnisch, E.Huster, Naturwiss. 41, 495 (1954).

Rb^{87} 37 50 $\sim 5 \times 10^{10y}$

τ 4.6×10^{10y} 5

From Rb^{87}/Sr^{87} in minerals of ages determined from A^{40}/K^{40} by chem

K.Fritze, F.Strassman, Z.Naturf. 11a, 277 (1956).

τ 5.0×10^{10y} 2

From Rb^{87}/Sr^{87} in minerals of ages determined from Pb/U by ms

L.T.Aldrich, G.W.Wetherill, G.R.Tilton, G.L.Davis, Phys. Rev. 103, 1045 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31 H6 (1956).

Ro^{87} 37 50

Level $Rb^{87}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.4$

γ 0.407 $\epsilon B(E2) = 0.0058$

L.W.Fagg, E.H.Geer, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

Rb^{88} 37 51 18^m

$Rb^{(87)}$(n,γ)

β^- 76% (5.30) 47 pc 1.85γ/β

$\gamma(Sr^{88})$

631†	0.908 4	14†	3.01 5		scin
62†	1.39 3	14†	3.24 3		
1000†	1.850 8	11†	3.52 5		
45†	2.11 3	4†	3.68 5		
107†	2.68 5	14†	4.87 5		

(1.85$\gamma\gamma$(1.39, 2.11, 2.68γ) (2.11$\gamma\gamma$(0.908γ)

N.H.Lazar, E.Eichler, G.D.O'Kelley, Phys. Rev. 101, 727 (1956).

Rb^{89} 37 52 15^m

d 3^mKr from U^{235}(n,f) chem

τ 14.9^m 3

β^- 5% 2.81 15 scin

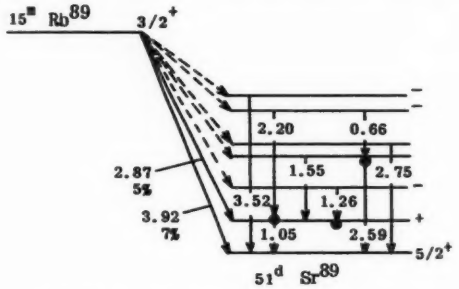
7% 3.92

$\gamma(Sr^{89})$

217†	0.663 6	190†	2.20 2		scin
1000†	1.05 2	169†	2.59 3		
717†	1.26 1	37†	2.75 5		
48†	1.55 3	29†	3.52 7		

(1.05$\gamma\gamma$(1.26γ) (2.59$\gamma\gamma$(0.663γ) Σ scin, scin

(1.05$\gamma\gamma$(2.20γ) No γ(2.75, 3.25$\gamma\gamma$) Σ scin



G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 102, 223 (1956).

Sr 38 — Resonance peaks — Sr(n) — E_n = 6 to 102 kev, Li(p,n)

15* kev	l_n = 0	
27		
31		
95*	l_n = 0	

*Assigned to Sr^{89}

H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williamson, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956).

Sr^{83} 38 45 — 38^h — τ — 34^h — Ag(480-Mev p) chem

p 83^dRb chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

Sr^{87} 38 49 — 2.8^h — γ — **(0.388)** — α = 0.26 *3* — GM

Authors conclude γ is E5

I.V.Estulin, E.M.Moiseeva, Soviet Phys. JETP 1, 463 (1955); Zhur. Eksptl' i Teoret. Piz. 28, 541 (1955).

Sr^{88} 38 50 — γ — $Sr^{(88)}(n,n'\gamma)$ — E_n = 4.4

0.88 *1*	scin
1.85 *1*	

R.M.Sinclair, Westinghouse Research Report 60-94511-6-R12 (1956).

Sr^{89} 38 51 — 51^d — τ — 51^d *1* — U(150-Mev p) chem

A.Kjelberg, A.C.Pappas, Nuclear Phys. 1, 322 (1956).

$Sr^{(88)}$(pile n,γ) chem

β^- 100% **1.462** *5* ΔJ = 2, yes shape sl

Not p $14^s Y^{89}$ ($< 5 \times 10^{-4}$%) no 0.91γ scin

A.Bisi, S.Terrani, L.Zappa, Nuovo Cim. 2, 1297 (1955).

p $14^s Y^{89}$ (0.02%) 0.91γ/β

W.S.Lyon, R.R.Rickard, Phys. Rev. 100, 112 (1955).

Y 39 — Relative isotopic abundances — ms

No Y^{85}, Y^{86}, Y^{87} ($< 10^{-4}$%)

No Y^{88}, Y^{90}, Y^{93}, Y^{94} ($< 5 \times 10^{-4}$%)

No Y^{91}, Y^{92} ($< 2 \times 10^{-4}$%)

No Y^{95} ($< 3 \times 10^{-4}$%)

D.C.Hess, ANL-5420 (1956).

Y^{88} 39 49 — 105^d — e.s. — β^+ — **0.58** — Sr(10-Mev d); sd

No 0.83β (ascribed to internal pairs from 1.83γ)

W.L.Stirling, N.Goldberg, Bull. Am. Phys. Soc. 1, No. 6, 291 K6 (1956).

Y^{88} 39 49 — 105^d — e.s. — γ(Sr^{88}) — $Sr^{(88)}$(p,n) chem

92†	**0.908**	scin
100†	**1.85**	
0.5†	**2.76**	

(0.908γ)(1.85γ) Σ scin

N.H.Lazar, E.Eichler, G.D.O'Kelley, Phys. Rev. 101, 727 (1956).

γ(Sr^{88}) **(0.91)** 100% dipole $\gamma\gamma(\theta)$

(1.85) 100% quadrupole

(0.91γ)(1.85γ)(θ) J = 3, 2, 0

E.D.Klema, Phys. Rev. 102, 449 (1956); Bull. Am. Phys. Soc. 1, No. 2, 85 D2 (1956).

γ(Sr^{88}) **(0.91)** parity change $\gamma\gamma(L)$

(1.85) no parity change

E2 $s\pi e^+e^-(\theta)$

C.F.Coleman, Phil. Mag. 1, 166 (1956).

Y^{88} 39 49 — 0.3^{ms} — τ — 2.93×10^{-4}s *20* — 85^dZr source

Used statistical correlation method

M.D.Petroff, W.O.Doggett, Rev. Sci. Instr. 27, 838 (1956).

Y^{88} 39 49 — γ — $Y^{89}(\gamma,n\gamma)$ — $E_\gamma \leq 22$; scin

0.045 *5**	
0.393 *15*	$\tau = 0.287^{ms}$ *15*

*Assignment uncertain

S.H.Vegors, Jr., P.Axel, Phys. Rev. 101, 1067 (1956).

Y^{89} 39 50 — Levels — $Y^{89}(n,n')16^s Y$ — E_n = 0.9 to 1.8

(0.91) $\tau = 16.1^s$ *3*

1.2

1.2 level feeds 16^s state; 1.53 level does not

C.P.Swann, F.R.Metzger, Phys. Rev. 100, 1329 (1955).

Y^{90} 39 51 — 64^h — τ — 64.8^h — d Sr^{90} chem

Followed for 14 half lives

E.V.Marathe, J. Sci. Industrial Res. India 14B, 354 (1955).

$e^+/\beta^- = 3.6 \times 10^{-5}$ *9* sl, $\gamma^\pm\gamma^\pm$

e^+ chiefly from nuclear pairs from 1.75 transition in Zr^{90}

J.S.Greenberg, M.Deutsch, Phys. Rev. 102, 415 (1956).

$Y^{90}_{39\ 41\ 64^h}$ d Sr^{90} chem

$ce/\beta = 1.6 \times 10^{-4}$ *6*] ce's correspond sl
$ce_K/\beta \sim 1.06 \times 10^{-4}$] to $E_\gamma = 1.736$
No photons with $E_\gamma \sim 1.74$ ($< 4.3 \times 10^{-4}$%) scin

T. Yuasa, J. Laberrigue-Frolow, L. Feuvrais, J. phys. radium 17, 558 (1956); Compt. rend. 242, 2129 (1956).

Zr 40 Relative isotopic abundances ms
No Zr^{84} ($< 3 \times 10^{-4}$%)
No Zr^{85}, Zr^{86}, Zr^{87}, Zr^{88} ($< 2 \times 10^{-4}$%)
No Zr^{89} ($< 10^{-2}$%) No Zr^{93} ($< 2 \times 10^{-3}$%)
No Zr^{95}, Zr^{97}, Zr^{98}, Zr^{99}, Zr^{101} ($< 10^{-3}$%)
No Zr^{100} ($< 5 \times 10^{-4}$%)

D.C. Hess, ANL-5420 (1956).

Levels $Zr(n,n')$ $E_n = 4.3$; scin
g.s. pulsed n's
1.4
2.2
2.8 ?
No 0.90 level

R.V. Smith, Bull. Am. Phys. Soc. 1, No. 1, 55, R6 (1956); verbal report.

Level $Zr(n,n')$ $E_n = 2.45$
$\sigma(90°)$ Level pulsed n's
23 *2* **0.94** *4* σ units: mb/sterad

L. Cranberg, J.S. Levin, Phys. Rev. 103, 343 (1956).

Level $Zr(n,n'\gamma)$ $E_n = 4.4$
γ **0.92** *2* scin

R.M. Sinclair, W.S. Emmerich, Westinghouse Research Report 60-94511-6-R11 (1956).

Level $Zr(n,n'\gamma)$ $E_n = 0.9$ to 2.2
γ **0.930** scin
No other γ observed with $0.6 < E_\gamma < 2$

J.B. Guernsey, C. Goodman, Phys. Rev. 101, 294 (1956).

γ $Zr(n,n'\gamma)$ $E_n = 0.35$ to 3.9 scin

E_γ	Thresh
0.552 *5*	1.48 *5*
0.916 *15*	0.92 *2*
1.46 *3*	1.46 *3*

Probably due to Zr^{92}, Zr^{94}

R.B. Day, A.E. Johnsrud, D.A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

Zr 40 Resonance Zr(n) $E_n = 2$ to 80 kev,
peak **43** kev Li(p,n)
Assigned to Zr^{91}
Graph given showing 10 more peaks

H.W. Newson, J.H. Gibbons, H. Marshak, R.M. Williamson, R.A. Mobley, A.L. Toller, R. Block, Phys. Rev. 102, 1580 (1956).

$Zr^{89}_{40\ 49}$ $Zr^{(90)}(\gamma,n)$ β tron
Threshold for $4.3^m Zr^{89}$ ($J = 1/2$) = 12.37 *9*
Yield of $79^h Zr^{89}$ ($J = 9/2$) small below 12.37

P. Axel, J.D. Fox, Phys. Rev. 102, 400 (1956); 100, 1249A (1955).

$Zr^{90}_{40\ 50}$ γ $Zr^{(90)}(n,n'\gamma)$ $E_n = 0.35$ to 3.9
2.17 *3* Thresh = 2.20 *3* scin
2.30 *3*
3.29 *10*
Also $\gamma^{\pm}$ with threshold at 1.77 *3* due to pairs from 0^+ level at 1.77

R.B. Day, A.E. Johnsrud, D.A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

$Zr^{91}_{40\ 51}$ ground state
μ -1.9 *2* S

K. Murakawa, Phys. Rev. 100, 1369 (1955).

Level $Zr^{(91)}(n,n'\gamma)$ $E_n = 0.35$ to 3.9
γ **1.22** *3* Thresh = 1.26 *5* scin

R.B. Day, A.E. Johnsrud, D.A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

$Zr^{92}_{40\ 52}$ Level $Zr^{92}(n,n'\gamma)$ $E_n = 1$ to 5.5
γ **0.926** *9* scin
γ of same energy observed in $Zr^{94}(n,n'\gamma)$, q.v.

G.L. Griffith, Phys. Rev. 103, 643 (1956).

$Zr^{94}_{40\ 54}$ Level $Zr^{94}(n,n'\gamma)$ $E_n = 1$ to 5.5
γ **0.926** *9* scin
γ of same energy observed in $Zr^{92}(n,n'\gamma)$, q.v.

G.L. Griffith, Phys. Rev. 103, 643 (1956).

$Zr^{95}_{40\ 55\ 65^d}$ β^- 11% **0.250** *30* s
53% **0.364** *8*
34% **0.404** *8*
0.9% **0.90** *3*
0.4% **1.13** *4*
$\gamma(Nb^{95})$ **0.723** *2* M1,E2 s ce
0.756 *2* E1
p $90^h Nb^{95}$ (0.235 γ observed)

P.P. Zarubin, Izvest. Akad. Nauk Ser. Fiz. SSSR 18, 563 (1954).

$Zr^{96}_{40\ 56}$ $\tau_{\beta\beta}$ 85% Zr^{96}; 4π scin

$> 5x10^{17}$y $\beta\beta$

$> 3.6x10^{17}$y β

Search covered $2.5 < E_\beta < 4.5$

Long τ suggests ν and anti-ν are nonidentical

M. Awschalom, Phys. Rev. 101, 1041 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31 H7 (1956).

$Zr^{97}_{40\ 57}$ 17^h

U(n,f) chem

$\gamma(Nb^{97})$	**0.58** *3* ?	scin $\gamma\gamma$
1†	**1.02*** *3*	scin
2†	**1.15** *2*	
0.5†	**1.72** *3*	

(1.15γ)(0.58γ?) scin

β(1.02, 1.15, 1.72γ)

Also observed 1.28, 1.77γ (< 0.5†)

†Relative to intensity of 96 for $60^s Nb^{97}$ 0.75γ

*Present after Zr chem; intensity grows. See Nb^{97}

R. Nordhagen, J. Thomassen, Nuclear Phys. 1, 499 (1956).

Nb 41 Relative isotopic abundances ms

Nb^{93} **100.0%**

No Nb^{89}, Nb^{90} ($< 12 \times 10^{-5}$%)

No Nb^{91}, Nb^{92}, Nb^{94} ($< 19 \times 10^{-5}$%)

No Nb^{95}, Nb^{96}, Nb^{97}, Nb^{98} ($< 1 \times 10^{-4}$%)

F. M. White, T. L. Collins, F. M. Rourke, Phys. Rev. 101, 1786 (1956).

Nb ? 41 γ $Nb^{93}(\gamma,?\gamma)$ $E_\gamma \leq 22$; scin

0.088 *5* $\gamma\gamma$ delay = $6.0^{\mu\mu s}$ *15*

S. H. Vegors, Jr., R. B. Duffield, Bull. Am. Phys. Soc. 1, No. 4, 206 R1 (1956).

$Nb^{90}_{41\ 49}$ 15^h g.s.

β^+	**1.51** *3*			scin
$\gamma(Zr^{90})$		10.4†	**1.82**	scin
109†	**0.14***	11.5†	**1.96**	
8†	**0.14***	26†	**2.19**	
180†	**1.14**	150†	**2.32** *2*	

(~0.14γ)($\gamma^\pm$, 1.14, 1.82, 2.19γ)

(1.51β)(1.14γ) No (2.32γ)γ

*Coincidence measurements imply two 0.14 γ's

N. H. Lazar, G. D. O'Kelley, Bull. Am. Phys. Soc. 1, No. 4, 163 B9 (1956); verbal report.

$Nb^{95}_{41\ 54}$ 35^d g.s.

β^-	**0.162** *5*	$65^d Zr^{95}$ source; s
$\gamma(Mo^{95})$	**0.764** *2*	s ce

P. P. Zarubin, Izvest. Akad. Nauk Ser. Fiz. SSSR 18, 563 (1954).

U(n,f) chem

$\gamma(Mo^{95})$ **0.767** *2* scin

K. E. Johansson, Arkiv Fysik 10, 247 (1956).

$Nb^{97}_{41\ 56}$ 74^m g.s.

$\gamma(Mo^{97})$ d 17^h Zr chem

100†	**0.66** *1*	scin
1†	**1.02** *3*	

R. Nordhagen, J. Thomassen, Nuclear Phys. 1, 499 (1956).

$_{42}Mo$ Mo(n) E_n = 1 to 80 kev,

Graph given indicating possibly Li(p,n)

9 weak resonance peaks

H. W. Newson, J. H. Gibbons, H. Marshak, R. M. Williamson, R. A. Mobley, A. L. Toller, R. Block, Phys. Rev. 102, 1580 (1956); 94, 774A (1954).

Levels Mo(n,n') E_n = 2.45

$\sigma(90°)$	Level	
42 *4*	**0.83** *4*	pulsed n's
52 *4*	**1.56** *3*	σ units: mb/sterad

L. Cranberg, J. S. Levin, Phys. Rev. 103, 343 (1956).

Resonances Mo(n) chopper

E_o(ev)	Γ_n(mev)*	Isotope
45 *0.5*	188 *30*	96
72 *1*	24 *6*	98
134 *2.5*	170 *55*	97

Resonances also observed at 162, 189, 283, 350, 400, 483, 715, 842 ev

*Assuming Γ_γ = 260 mev

J. A. Radkevich, V. V. Vladimirsky, V. V. Sokolovsky Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Mo ? 42 γ $Mo(\gamma,?\gamma)$ $E_\gamma \leq 22$; scin

0.098 *5** $\gamma\gamma$ delay = $16.5^{\mu s}$ *12*

*Threshold = 8.4 ± 0.6

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

$Mo^{90}_{42\ 48}$ 5.7^h

τ 6.4^h Ag(550-Mev α) chem

p 15^hNb chem

B. V. Kurchatov, V. N. Mekhedov, N. I. Borisova M. Y. Kuznetsova, L. N. Kurchatova, L. V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

$Mo^{91}_{42\ 49}$ 16^m g.s.

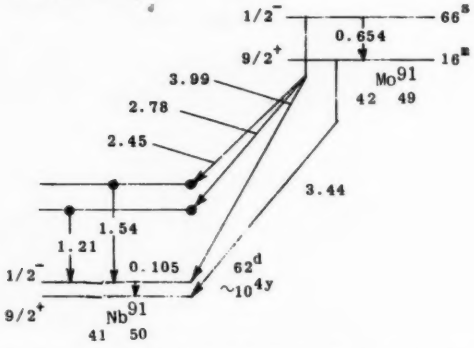
β^+ **3.44** $Mo^{(92)}$ ($\leq$22-Mev γ,n); s

No (3.44β)γ scin

N. Gove, F. A. Smith, R. A. Becker, Phys. Rev. 100, 1236A (1955); verbal report.

$^{Mo^{91}}_{42\ 49}$ $^{66^s}$

β^+ 51† 2.45 $Mo^{(92)}$ ($\leq$22-Mev γ,n); s
35.8† 2.78
13.2† 3.99
$\gamma(Mo^{91})$
8.9* **0.654** *3* $\alpha = 0.055$ s ce, scin
$\gamma(Nb^{91})$ **1.21** scin
1.54
(2.78 β)(1.21 γ) (2.45 β)(1.54 γ)
No β(0.654 γ)
*ce per 100 β^+



N.Gove, F.A.Smith, R.A.Becker, Phys. Rev. 100, 1236A (1955); verbal report.

$^{Mo^{95}}_{42\ 53}$

ground state
J 5/2 para

J.Owen, I.M.Ward, Phys. Rev. 102, 591 (1956).

ground state
J **7/2** S

K.Murakawa, Phys. Rev. 100, 1369 (1955).

$^{Mo^{97}}_{42\ 55}$

ground state
J 5/2 para

J.Owen, I.M.Ward, Phys. Rev. 102, 591 (1956).

ground state
J **7/2** S

K.Murakawa, Phys. Rev. 100, 1369 (1955).

$^{Mo^{105}}_{42\ 63}$ $^{\sim 5^m}$

τ $<2^m$ U(fast n,f) chem

J.Flegenheimer, G.B.Baró, A.Medina, Z. Naturf. 10a, 798 (1955).

$^{Tc^{98}}_{43\ 55}$ $^{10^{5y}}$

τ_β **1 x 10^{5y}*** from $\gamma\gamma$ count in sample of known number of Tc^{98} atoms
$\gamma(Ru^{98})$ **0.660*** **0.750***
(0.750 γ)(0.660 γ)*

Continued

$^{Tc^{98}}_{43\ 55}$ $^{10^{5y}}$

Continued

No primordial Tc^{98} chem,n activation,ms
$6.0^h Tc^{99}$ found by n activation in 2 out of 18 samples believed produced from 2.2×10^{5y} Tc^{99}
$\sigma \leq 1.0$ and ~ 0.05 for $Tc^{98}(n,\gamma)$ and $Tc^{99}(n,n')$ resp. for production of $6.0^h Tc^{99}$

G.E.Boyd, Q.V.Larson, J.Phys. Chem. 60, 707 (1956); *G.D.O'Kelley, Q.V.Larson, G.E.Boyd, ibid.

n activation of various ores chem
Yield of $6.0^h Tc^{99}$ in Tc fraction was 1.40 to 2.85 times yield of $6.0^h Tc^{99}$ in Mo fraction in 7 out of 12 samples
If all $6.0^h Tc^{99}$ was produced by $Mo^{98}(n,\gamma\beta)$, the expected yield ratio was 0.96
Data interpreted as evidence of Tc^{98} in nature

E.Anders, R.N.Sen Sarma, P.H.Kato, J. Chem. Phys. 24, 622 (1956).

$^{Tc^{99}}_{43\ 56}$ $^{6.0^h}$

carrier-free source from Mo^{99}
γ **(0.140)** K/LM = 5.87 *12* sl
$\omega_K = 0.70$ *3* found from e_{AK}/ce_K

J.Laberrigue-Frolow, P.Radvanyi, Compt. rend. 242, 901 (1956).

$^{Tc^{104}?}_{43\ 61}$ $^{3.8^m}$ g.s.?

Ru(fast n),U(28-Mev d,f) chem
τ 3.8^m 2
β^- ~ 2 a
$\gamma(Ru^{104})$ >1 scin
E_{dis} ~ 4 GM E_γ/β
Sign of β's from magnetic deflection

J.Flegenheimer, W.Seelmann-Eggebert, Z. Naturf. 11a, 678 (1956); 9a, 806 (1954).

$^{Tc^{104}?}_{43\ 61}$ $^{18^m}$

Ru(fast n),U(28-Mev d,f) chem
τ 18^m
β^- ~ 3 a
$\gamma(Ru^{104})$ ~ 1.5 scin
$E_\gamma/\beta = 2.5$ Mev/β GM

Not produced by Mo(5 to 28-Mev d), Ru(28-Mev d), Mo(56-Mev α)

J.Flegenheimer, W.Seelmann-Eggebert, Z. Naturf. 11a, 678 (1956); 9a, 806 (1954).

$^{Tc^{105}}_{43\ 62}$ $^{10^m}$

τ 10^m *1* U(fast n, f) chem
p $4.4^h Ru^{105}$

J.Flegenheimer, G.B.Baro , A.Medina, Z. Naturf. 10a, 798 (1955).

Ru 44

Relative isotopic abundances ms

Ru^{96}	5.57% *8*		
Ru^{98}	1.86% *4*	Ru^{101}	17.1% *1*
Ru^{99}	12.7% *1*	Ru^{102}	31.6% *2*
Ru^{100}	12.6% *1*	Ru^{104}	18.3% *1*

No Ru^{94}, Ru^{95}, Ru^{97} (<0.010%)
No Ru^{103} (<0.0001%) No Ru^{105} (<0.0007%)
No Ru^{106} (<0.0010%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Relative isotopic abundances ms
No Ru^{86} ($< 25 \times 10^{-4}$%)
No Ru^{92}, Ru^{93}, Ru^{95}, Ru^{107} ($< 10^{-2}$%)
No Ru^{94}, Ru^{109} ($< 3 \times 10^{-3}$%)
No Ru^{97} ($< 3 \times 10^{-2}$%) No Ru^{103} ($< 15 \times 10^{-3}$%)
No Ru^{105} ($< 4 \times 10^{-2}$%) No Ru^{106} ($< 2 \times 10^{-3}$%)
No Ru^{108} ($< 10^{-3}$%)

D.C.Hess, ANL-5420 (1956).

Ru^{95} 44 51 1.6^h

τ		**1.65^h** *5*		$Ru^{(96)}(n,2n)$	chem
β^+	1†	**1.2** *1*			a
$\gamma(Tc^{95})$					
	~1†	**0.145**	0.5†	**0.640** *8*	scin
	4†	**0.340** *8*	1†	**1.110** *20*	

E.Schalscha, Nuclear Phys. 1, 481 (1956).

τ **1.7^h** *1* Ag(480-Mev p) chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans.p. 111

Ru^{99} 44 55

ground state

J **5/2** natural Ru; S
μ **-0.63*** *15*
*Calculated from $\bar{\mu}$ (for A = 99, 101) = -0.66 *2*, using $\mu_{101}/\mu_{99} = 1.09$ *3*[6]

K.Murakawa, J. Phys. Soc. Japan 10, 919 (1955); 9, 427, 651 (1954). $J.H.E.Griffiths, J.Owen, Proc. Phys. Soc. 65A, 951 (1952).

Ru^{101} 44 57

ground state

J **5/2** natural Ru; S
μ **-0.69*** *15*
*Calculated from $\bar{\mu}$ (for A = 99, 101) = -0.66 *2*, using $\mu_{101}/\mu_{99} = 1.09$ *3*[6]

K.Murakawa, J. Phys. Soc. Japan 10, 919 (1955); 9, 427, 651 (1954). $J.H.E.Griffiths, J.Owen, Proc. Phys. Soc. 65A, 951 (1952).

Rh^{98} 45 53 8.7^m

τ	**8.7^m** *1*		d 17^{m}Pd chem
β^+	**2.5** *2*		scin
$\gamma(Ru^{98})$	**0.650** *10*		scin

$(2.5\beta)(0.650\gamma)$ No other β or γ

S.Katcoff, H.Abrash, Phys. Rev. 103, 966 (1956).

Rh^{99} 45 54 4.7^h

τ		**4.7^h** *1*			d 22^{m}Pd chem
β^+	10%	**0.74**			scin, pc
$\gamma(Ru^{99})$	70%*	**0.335** *10*			scin, x/γ
	20%	**0.615** *15*		**1.26** *3*	
	w	**0.89** *2*	w	**1.41** *4*	
x		**K x ray**			scin

$(0.74\beta)(0.335\gamma)$ $(0.335\gamma)(0.89\gamma)$
No other $\beta\gamma$ or $\gamma\gamma$ *Used $\omega_K = 0.80$, $\epsilon_K/\epsilon \sim 0.90$

S.Katcoff, H.Abrash, Phys. Rev. 103, 966 (1956).

Rh^{99}? 45 54 15^d

τ	**16^d** *1*	
$\gamma(Ru^{99})$	**0.088**	scin
	0.348	

$(0.088\gamma)(0.348\gamma)$

K.Hisatake, J.T.Jones, J.D.Kurbatov, Bull. Am. Phys. Soc. 1, No. 5, 271 (1956).

Rh^{101} 45 56 4.7^d

τ	**4.7^d** *2*	d 8.5^{h}Pd chem
$\gamma(Ru^{101})$	**0.312** *10*	scin

No β^+ No other γ

S.Katcoff, H.Abrash, Phys. Rev. 103, 966 (1956).

Rh^{101}? 45 56 ~5^y

τ	**>3^y**	
$\gamma(Ru^{101})$	**0.125**	scin
	0.190	

$(0.190\gamma)(0.125\gamma)$
γ's fit into levels found in $Ru^{101}(\alpha,\alpha')$

K.Hisatake, J.T.Jones, J.D.Kurbatov, Bull. Am. Phys. Soc. 1, No. 5, 271 (1956).

$\gamma(Ru^{101})$	**(0.125)**	$\alpha_K = 0.4$	scin $x\gamma/\gamma\gamma$
	(0.195)	$\alpha_K = 0.7$	

$(0.195\gamma)(0.125\gamma)$ delay < 1.4 $^{m}\mu s$
Authors attributed γ's to 210^d Rh^{102}

N.Perrin, L.Dick, R.Foucher, H.Vartapetian, J. phys. radium 17, 539 (1956).

Rh^{102} 45 57 210^d

τ	**210^d** *10*	
$\gamma(Ru^{102})$	**0.475**	scin
	0.630	
	1.100	

$(0.475\gamma)(0.630\gamma)(1.100\gamma)$

K.Hisatake, J.T.Jones, J.D.Kurbatov, Bull. Am. Phys. Soc. 1, No. 5, 271 (1956).

Rh^{102} 45 57 210^{d}

$\gamma(Ru^{102})$ Ru(28-Mev d) chem

	54†	**0.125** 5			scin
	58†	**0.200** 4	10†	**0.72** 2	
	80†	**0.475** 5	10†	**0.79** 2	
	26†	**0.635** 5	56†	**1.08** 1	
x	100†	**Ru K x ray**			pc, crit a

No 0.086, 0.353γ scin
No β^{+} (< 10%) no $\gamma^{\pm}$ scin
No Pd K x ray (< 5†) pc

P. Avignon, Ann. Phys. 1, 10 (1956); Compt. rend 240, 176 (1955).

Rh^{103} 45 58

Levels $Rh^{103}(n,n'\gamma)$ $E_n \sim 10$

0.040 level

τ **57.5^{m}** 5

$Rh^{103}(p,p'\gamma)$ $E_p = 0.9$ to 1.3

0.040 level scin K x ray

E3 Coulomb excitation shown. $\sigma = 3.7 \times 10^{-10}$ at $E_p = 0.90$ (used $\alpha_K = 40$, $\alpha_L = 470$)

0.365 level $E_p = 2.67$

γ	0.06†	**(0.325)**
	100†	**(0.365)**

†Branching ratio from yield of K x ray after bombardment to 0.365γ's during bombardment

G. A. Jones, W. R. Phillips, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22, (1956); priv. comm.

Level $Rh^{103}(p,p'\gamma)$

γ **0.305** E2/M1 = 0.032 p,γ(L)
B(E2) = 0.208

P. H. Stelson, F. K. McGowan, Bull. Am. Phys. Soc. 1, No. 4, 164 C2 (1956); verbal report.

Rh^{105} 45 60 36.5^{h} g.s.

Ru^{104} (pile n,$\gamma\beta$) chem

β^{-}	30%	**0.247** 5		sl $\beta\gamma$
	70%	**0.560** 5		sl
$\gamma(Pd^{105})$		**0.310** 5	$\alpha_K = 0.018$ 6	sl ce

No 0.063γ (photons < 0.1%) scin, sl ce
(0.247β)(0.310γ)/$\beta \sim 0.25$ sl

J. Laberrigue-Frolow, Ann. Phys. 1, 152 (1956); Compt. rend. 240, 287 (1955).

Rh^{106} 45 61 30^{s} g.s.

$\gamma(Pd^{106})$ $1.0^{y}Ru^{106}$ source

	100†	**0.513**			scin pr,
	53†	**0.624**	1.0†	**1.77** 4	scin
	3†	**0.87**	0.6†	**1.96** 5	
	8†	**1.045**	0.5†	**2.10** 5	
	≤ 0.8†	**1.14** ?	1.0†	**2.37** 6	
	2.5†	**1.55** 4	0.2†	**2.66** 7	

No 0.41γ (< 2†) scin $\gamma\gamma$, scin
No 0.22, 0.72, 0.805, ~1.21, 1.39, 1.85 γ
(0.513γ)(0.62, 1.04γ; others with $E_\gamma < 2.0$)
(1.04γ)(0.87γ)
Decay scheme proposed

D. E. Alburger, B. J. Toppel, Phys. Rev. 100, 1357 (1955).

Pd ? 46 γ $Pd(\gamma,?\gamma')$ $E_\gamma \leq 22$; scin

0.180 15 } $\gamma\gamma'$ delay = 33$^{\mu s}$ 6
0.305 15 }

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

Pd 46 Resonances Pd(n) chopper

E_o(ev)	$g\Gamma_n$(mev)	Γ_γ(mev)
11.68 12	0.030 3	220 63
13.05 13	0.23 4	241 73
24.8 2	0.278 200	292 200
32.5 5	13.7 39	180 52
55 1	0.85 30	
77.8 20	0.50 16	
89.5 24	95	
148 5	2.66 70	
183 7	8.8 19	
283 15	50 15	
355 20	12.8 77	
427 27	43 10	
891 80		

J. A. Radkevich, V. V. Vladimirsky, V. V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Pd^{98} 46 52 17^{m}

Ru^{96}(19-Mev α,2n) chem

τ **17.5^{m}** 5

From milking of 8.7^{m}Rh from Pd

S. Katcoff, H. Abrash, Phys. Rev. 103, 966 (1956).

Pd^{99} 46 53 22^{m}

Ru^{96}(17-Mev α,n) chem

τ		**21.6^{m}** 6		p 4.7^{h}Rh chem
β^{+}		**2.0** 1		scin, a
$\gamma(Rh^{99})$	s	**0.140**	**0.420**	double
		0.275	**0.670**	scin

(2.0β)(0.140, 0.670γ)
(0.140γ)(0.275, 0.420, 0.670γ)
(0.275γ)(0.140, 0.670γ)
(0.420γ)(0.140, 0.420γ)
$\gamma^{\pm}$(0.140, 0.275, 0.670γ)

S. Katcoff, H. Abrash, Phys. Rev. 103, 966 (1956).

Pd^{100} 46 54 4.0^{d}

τ **4.1^{d}** 2 Ag(480-Mev p) chem

B. V. Kurchatov, V. N. Mekhedov, N. I. Borisova M. Y. Kuznetsova, L. N. Kurchatova, L. V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

$Pd^{101}_{46\ 55}$ 8.5^h

τ 8.5^h 3 — Ru^{99}(17-Mev α,n), Ru^{99}(40-Mev α,2n) chem

β^+	~4%	0.58	4			scin, a
$\gamma(Rh^{101})$						scin, x/γ
	15%	0.288	9	double		
	15%	0.59	2	w	1.19 4	
	w	0.72	2	w	1.28 4	

(0.288 γ)(0.288γ) No $\beta\gamma$

S. Katcoff, H. Abrash, Phys. Rev. 103, 966 (1956).

$Pd^{103}_{46\ 57}$ 17^d

$\gamma(Rh^{103})$			
~150*	0.052 1	K/L~0.8	sl ce
1.5*	0.324 5		
(photon 0.040γ)/(K x ray) ~0.003			pc
No 0.013, 0.053 photons			pc
No ce with 0.049 < E_{ce} < 0.10 (<0.09*)			sl ce

*ce per 1000 ce_L of $57^m Rh^{103}$ 0.040γ

P. Avignon, Ann. Phys. 1, 10 (1956).

Ag 47 — Level — Ag(p,p'γ)

γ ~0.315 E2/M1 = 0.032 p,$\gamma(L_s)$
B(E2) = 0.226

P. H. Stelson, F. K. McGowan, Bull. Am. Phys. Soc. 1, No. 4, 164 C2 (1956); verbal report.

Ag(n,γ) pulsed n's

Resonances E_o(ev)	Γ_n^{o*}	E_o(ev)	Γ_n^{o*}	E_o(ev)	Γ_n^{o*}
16.3	1.56	51.6	5.2	139.0	0.38
30.5	2.8	55.9	2.9	143.5	1.1
40.5	2.4	71.2	5.7	172.4	7
41.6	2.4	88.0	1.1	201.4	2.0
45	0.25	133.4	11	208	2.8
*Assuming g = 1/2; abundance 50%				251	13

Resonances also observed at 259, 264, 272, 290, 300, 310, 316, 326, 360, 386, 396, 403, 427, 443, 459, 466, 486, 499, 513, 523, 554, 563, 575, 586 ev *mev

See also Ag^{108}, Ag^{110}

J. Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$Ag^{103}_{47\ 56}$ 59^m

τ 59^m 6 — $Ag^{(107)}$(50-Mev p,5nβ) chem

F. A. Johnson, Can. J. Phys. 33, 841 (1955).

$Ag^{104}_{47\ 57}$ 27^m

τ	27^m 1		d 59^mCd chem
β^+	2.70 1		59^mCd source; sl
$\gamma(Pd^{104})$			
2*	0.1184		sπ ce
7*	0.5562	K/L~7	

*Relative ce_K intensities

F. A. Johnson, Can. J. Phys. 33, 841 (1955); Proc. Roy. Soc. Canada 46, 135A (1952).

$Ag^{105}_{47\ 58}$ 45^d

$\gamma(Pd^{105})$ — Pd(22-Mev d) chem

>20*	0.065	K/L > 0.1	scin, sl ce
7.5*	0.117	= 1.7	sl ce
42*	0.158		
68*	0.185	= 4.2	
475*	0.287	= 5.5	scin, sl ce
39*	0.328		sl ce
52*	0.351	= 0.6	
36*	0.395		
93*	0.446	= 7.2	scin, sl ce

*Relative ce_K intensities

All γ's have $\tau \gg 9^d$ so they are not due to Ag^{106}; the 0.117 γ may be due to Ag^{110}

D. E. Alburger, B. J. Toppel, Phys. Rev. 100, 1357 (1955).

$\gamma(Pd^{105})$ — Rh^{103}(25-Mev α,2n) chem

			K/LM		Pd(13-Mev d) chem
20†	0.0640	5	>5	M1	scin, sl ce
w	0.157	1			scin
•	0.184$	1	3.0		sl ce
60†	0.2810	5	8.2	M1	scin, sl ce
w	0.319	2			scin $\gamma\gamma$
w	0.331	2			scin $\gamma\gamma$
100†	0.345	1	5.8	E2	scin, sl ce
w	0.393	3			scin
~30†	0.443	1	7.0		scin, sl ce
~8†	0.654	5			scin

(K x ray)(0.064, 0.281, 0.345, 0.443, 0.654γ)
(0.064γ)(0.281γ) (0.319γ)(0.331γ)
(0.443γ)(0.654γ)

*ce only $Could be $\gamma(Ag^{105})$ or $\gamma(Pd^{105})$

R. W. Hayward, D. D. Hoppes, Bull. Am. Phys. Soc. 1, No. 1, 42, K4 (1956); verbal report.

$Ag^{106}_{47\ 59}$ 8.6^d

$\gamma(Pd^{106})$ — Pd(22-Mev d) chem

	0.22	180*	K/L = 3.2	scin,
	0.408	135*		sl ce
100†	0.513	567*	K/L = 7.7	
20†	0.624	95*		
20†	0.72	78*		
	0.805	45*		
31†	1.045	37*		sl ce, pe,
10†	1.131	13*		scin
~10† [	1.205	12*		
	1.225	7*		
10†	1.388	1.8*		sl ce,
33†	1.53	10*		scin pr
6†	1.72			scin pr
5†	1.85			
1†	2.10			
0.3†	2.63			

Other γ's with $2.0 < E_\gamma < 2.5$ scin pr

No 0.87, 1.96, 2.41 γ

*Relative ce_K intensities

Decay scheme proposed

D. E. Alburger, B. J. Toppel, Phys. Rev. 100, 1357 (1955).

$Ag^{107}_{47\ 60}$ Levels $Ag^{107}(p,p'\gamma)$ $E_p = 3.0$
$Ag^{107}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.0$

γ	**0.319** *3*	B(E2) = 0.16	scin
	0.419 *4*	= 0.23	

L.W.Fagg, E.A.Wolicki, R.O.Bondelid, K.L. Dunning, S.Snyder, Phys. Rev. 100, 1299; 98, 1538A (1955).

$Ag^{108}_{47\ 61}$ 2.3^m

β^-	**1.7** *1*	$Ag^{(107)}(n,\gamma)$; a
β^+		scin $\gamma^\pm$
$\gamma(Pd^{108})$	**0.405**	scin
$\gamma(Cd^{108})$	**0.639**	See also Ag^{110}

M.C.Joshi, B.V.Thosan, Proc. Indian Acad. Sci. 43A, 255 (1956).

$Ag^{108}_{47\ 61}$ Resonances $Ag^{(107)}(n;\ n,\gamma)$ pulsed n's; scin γ

E_o(ev)	$\sigma_o\Gamma$	Γ(mev)	$g\Gamma_n$(Mev)
16.3	250	120	3.2
41.6	240	~500	7.8
45.0	24	160	0.9
51.6	470	130	19

* For unassigned Ag resonances, see Ag

J.Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); G. Grimm et al., Phys. Rev. 98, 1161A (1955); W. W.Havens et al., Bull. Am. Phys. Soc. 1,No. 4, QUU P15 (1956); verbal report.

Resonances $Ag^{(107)}(n;\ n,\gamma)$ pulsed n's

E_o(ev)	J	Γ_γ(mev)	Γ_n(mev)
16.3	0	138	12
42	1	137 *19*	5.0 *4*
45		~200	
51.8	1	136 *16*	20.8 *9*

E.R.Rae, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Ag^{109}_{47\ 62}$ Levels $Ag^{109}(p,p'\gamma)$ $E_p = 3.0$
$Ag^{109}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.0$

γ	**0.306** *3*	B(E2) = 0.18	scin
	0.412 *4*	= 0.31	

L.W.Fagg, E.A.Wolicki, R.O.Bondelid, K.L. Dunning, S.Snyder, Phys. Rev. 100, 1299; 98, 1538A (1955).

$Ag^{110}_{47\ 63}$ $^{24^s}$ g.s.

β^-	**2.7** *1*	$Ag^{(109)}(n,\gamma)$; a
$\gamma(Cd^{110})$	**0.967**	scin

Samples fixed on endless belt irradiated by Po - Be source. Belt speed varied.

M.C.Joshi, B.V.Thosan, Proc. Indian. Acad. Sci. 43A, 255 (1956).

$Ag^{110}_{47\ 63}$ $^{24^s}$ g.s. β^- 100% **2.869** *20* S77
No other β (<5%), no γ, no $\beta\gamma$ S77, scin

R.F.Thomas,Jr., W.A.Whitaker, C.L.Peacock, Bull. Am. Phys. Soc. 1, No. 2, 86, D3 (1956), verbal report.

$Ag^{110}_{47\ 63}$ 270^d

β^-	55%	**0.086** *5*			S77
	43%	**0.536** *5*	No other β(<0.1%)		
$\gamma(Ag^{110})$	~2%	**0.116** *2*	K/LM = 1.07		S77 ce
$\gamma(Cd^{110})$		**0.447** *5*			S77 pe,ce;
		0.575 *5*	~7†	**0.820** *8*	scin
		0.620 *6*	100†	**0.883** *9*	
	100†	**0.656*** *6*	55†	**0.945** *9*	
		0.685 *7*	30†	**1.382** *13*	
		0.705 *7*		**1.492** *15*	
		0.759 *7*		**1.519** *15*	

*K/LM = 11 (0.656γ)(all strong γ's)

R.F.Thomas,Jr., W.A.Whitaker, C.L.Peacock, Bull. Am. Phys. Soc. 1, No. 2, 86, D3 (1956).

$\gamma(Cd^{110})$ S77 Cp

100†	**0.60 to 0.75**
87†	**0.85 to 1.00**
22.5†	**(1.39)**
14.6†	**(1.48 + 1.51)**

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956); Doklady Akad. Nauk SSSR 77, 597 (1951).

$Ag^{110}_{47\ 63}$ Resonances $Ag^{(109)}(n;\ n,\gamma)$ pulsed n's

E_o(ev)	J	Γ_γ(mev)	Γ_n(mev)
5.22	1	158 *11*	12.1 *9*
30.7	1	142 *13*	6.7 *5*
41	1	137 *19*	5.0 *4*
56	0	144 *11*	36.3 *14*
71	1	162 *6*	27.8 *7*
88	0	140 *21*	18.8 *14*

E.R.Rae, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Resonance $Ag^{(109)}(n)$
(5.2 ev) Γ_γ = 136 *6* mev

R.E.Wood, quoted by H.H.Landon, Phys. Rev. 100, 1414 (1955).

Resonances $Ag^{(109)}(n;\ n,\gamma)$ pulsed n's; scin

E_o(ev)	$\sigma_o\Gamma$	Γ(Mev)	$g\Gamma_n$(mev)
30.5	250	120	7.8
40.5	249	~50	7.7
55.9			11
71.2			24
88.0			5.2

For unassigned Ag resonances, see Ag

J.Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); G. Grimm et al., Phys. Rev. 98, 1161A (1955); W. W.Havens et al., Bull. Am. Phys. Soc. 1, No.4 177 P15 (1956);verbal report.

$Ag^{115}_{47\ 68\ 21^m}$ p 2.3^{d}Cd (92.3%) U(~150-Mev p) chem
p 43^{d}Cd (7.7%) U(~200-Mev d) chem

H.G.Hicks, R.S.Gilbert, Phys. Rev. 100, 1286 (1955).

Cd 48 Levels E_n = 2.45 pulsed n's

$\sigma(90°)$	Level
40 5	**0.64** 5
31 4	**1.36** 3
31 4	**1.49** 3

σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956); Bull. Am. Phys. Soc. 1, No. 1, 56 R10 (1956).

γ Cd(n,n'γ) E_n = 5.1 scin

0.52 2
2.80 2

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

Resonances Cd(n) E_n = 14.5 to 11000 ev chopper

Isotope	E_o(ev)	Isotope	E_o(ev)
114	**18.0**	112	**86.4**
112	**27.4**		**90.0**
114	**63.6**		
	66.8	112	**99.8**
114	**85.4**	114	**108.7**

Resonances also observed at 120.1, 139, 164, 192, 215, 225, 233, 259, 305, 387, 437, 500, 650 ev

Isotopic assignments made by using samples enriched in Cd^{111} and depleted in Cd^{113}

F.B.Simpson, R.G.Fluharty, Bull. Am. Phys. Soc. 1, No. 5, 247 C4 (1956).

Resonances Cd(n) chopper

E_o(ev)	E_o(ev)
18.0	**66.6**
27.2*	**88.2**$^\$$

Assigned to $^*Cd^{112}$, $^\$Cd^{111}$ q.v.

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Cd ? 48 Unassigned ce Ag(50-Mev p) chem

		sπ ce
0.06065		
0.12345	**0.5597**	**0.6312**
0.12461	**0.5949**	**0.6599**
0.15437	**0.6005**	**0.6645**
0.15832	**0.6009**	**0.6691**
0.2285	**0.6048**	**0.6846**
0.5338	**0.6267**	**0.7337**
0.5550	**0.6291**	**0.7436**

Assignable to Cd or daughter activities

F.A.Johnson, Can. J. Phys. 33, 841 (1955).

$Cd^{104}_{48\ 56\ 59^m}$ τ 59^m 2 Ag$^{(107)}$(50-Mev p,4n) chem
No β^+ sl
$\gamma(Ag^{104})$

40*	**0.0667**	K/L_1 = 10	M1	sπ ce
500*	**0.0836**	K/L_1 = 8	M1	
		$L_1:L_2:L_3$ = 60:2:1		
2*	**0.1236**			
2*	**0.1342**			

*Relative ce$_K$ intensities

F.A.Johnson, Can. J.Phys. 33, 841 (1955); Proc. Roy. Soc. Canada 46, 135A (1952).

τ 54^m 1 Ag(480-Mev p) chem

B.V.Kurchatov, V.N.Mekhedov, N.I.Borisova M.Y.Kuznetsova, L.N.Kurchatova, L.V. Christyakov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 178 July (1955); Consultants Bureau Trans. p. 111.

$Cd^{109}_{48\ 61\ 470^d}$ γ continuum limit of 0.423 retracted

G.Bertolini, A.Gallone, E.Lazzarini, Nuovo Cim. 2, Suppl. No. 3, 123 (1955); priv. comm.

$Cd^{111}_{48\ 63}$ 0.247 level 2.8^{d}In^{111} source
μ −0.783 23 $\gamma\gamma(\theta,H)$
Method independent of quadrupole interaction

R.M.Steffen, W.Zobel, Phys. Rev. 103, 126 (1956); 97, 1188 (1955).

Levels $Cd^{111}(p,p'\gamma)$ E_p = 3.0 scin

0.342 level

γ	13%	**0.092**	
	13%	**0.250**	
	87%	**0.342**	B(E2) = 0.10

(0.092γ)(0.250γ)

0.610 level

γ	2%	**0.270**		**0.092**
		0.360		**0.250**
	98%	**0.610**	B(E2) = 0.12	**0.342**

(0.270γ)(0.342γ) (0.360γ)(0.250γ)

F.K.McGowan, P.H.Stelson, M.M.Bretscher, Bull. Am. Phys. Soc. 1, No. 4, 164 C1 (1956); verbal report.

Level $Cd^{111}(p,p'\gamma)$
γ **0.342** E2/M1 = 0.152 p,γ(L)
B(E2) = 0.100

P.H.Stelson, F.K.McGowan, Bull. Am. Phys. Soc. 1, No. 4, 164 C2 (1956); verbal report.

Resonance Cd^{110}(n) chopper
88.2 ev Γ~0.34 ev σ_o = 19000
Γ_n~0.23 ev
Assumed Γ_γ = 0.12 ev

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Cd^{112}_{48\ 64}$ Resonance $Cd^{111}(n)$ chopper

27.2 ev $\Gamma = 0.130$ $\Gamma_n = 0.010$
$\sigma_o = 2400$ for $g = 1/4$
$\Gamma = 0.123$ $\Gamma_n = 0.003$
$\sigma_o = 2600$ for $g = 3/4$

Assumed $\Gamma_\gamma = 0.12$ ev

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Cd^{113}_{48\ 65}$ 5.1^y Cd^{112}(pile n,γ) scin γ/β

γ	~0.1†	0.265	E5	

Most K x rays observed ascribed to Cd^{109} scin
†Photons per 100 β

E. der Mateosian, M.Goldhaber, Bull. Am. Phys. Soc. 1, No. 4, 207 R6 (1956).

$Cd^{113}_{48\ 65}$ Levels $Cd^{113}(p,p'\gamma)$ $E_p = 3.3$ scin

0.582 level

γ	16%	0.282
	16%	0.300
	84%	0.582

B(E2) = 0.276
(0.282 γ)(0.300 γ)

0.675 level

γ	2%	0.300
	2%	0.375
	98%	0.675

(0.375 γ)(0.300 γ)

F.K.McGowan, P.H.Stelson, M.M.Bretscher, Bull. Am. Phys. Soc. 1, No. 4, 164 C1 (1956); verbal report.

Level $Cd^{113}(p,p'\gamma)$

γ	0.300	E2/M1 = 0.084	p,γ(L_1)
		B(E2) = 0.100	

P.H.Stelson, F.K.McGowan, Bull. Am. Phys. Soc. 1, No. 4, 164 C2 (1956); verbal report.

$Cd^{114}_{48\ 66}$ Capture γ's $Cd^{(113)}$(th n,γ) sπ Cp

42†	0.56 *1*	2.5†	2.78 *2*	
14†	0.66 *1*		2.91 *3*	
7.5†	0.73 *1*		3.00 *3*	
2†	~0.76 *2*		~3.41 *4*	
7†	0.82 *1*		**	
4†	1.23 *1.5*	1†	5.07 *7*	
4†	1.31 *2*	2†	5.33 *7*	
5†	1.37 *2*	1†	5.50 *6*	
3†	1.42 *2*	1.8†	5.72 *10*	
3†	1.52 *2*	3.5†	5.97 *7*	
3†	1.63 *2*	1.3†	6.06 *10*	
2†	1.79 *2*		6.75 *5*	
	1.82 *2*	0.8†	6.91 *5*	

Continued

$Cd^{114}_{48\ 66}$ Continued

	1.87 *2*	0.2†	7.12 *5*	
	2.15 *3*	0.1†	~7.46 *5*	
	2.28 *3*	0.6†	7.71 *5*	
5†	2.45 *2*	0.5†	7.86 *5*	
4†	2.56 *2*	0.4†	8.48 *3*	
4†	2.68 *2*	0.2†	9.04 *3*	

Levels proposed at 0.55, 1.20, 1.28, 1.38, 1.85, 2.15, 2.28, 3.00, 3.08, 3.33, 3.55, 3.72, 3.98
**Lines not resolved
†Photons/100 Cd captures

B.P.Adyasevich, B.D.Groshev, A.M.Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 270 July (1955); Consultants Bureau Trans. p. 195.

Capture γ's $Cd^{(113)}$(n,γ) scin Cp

100†	0.56 *2*	15†	2.53 *3**	
13†	1.32*	9†	3.27 *3**	

*Two or more unresolved γ's

T.H.Braid, Phys. Rev. 102, 1109 (1956).

$Cd^{116}_{48\ 68}$ $\tau_{\beta\beta}$ $>3 \times 10^{16}$y 81% Cd^{116}; Σ scin
From absence of counts from 2 to 3.5 Mev

J.F.Detoeuf, R.Moch, J. phys. radium 16, 897 (1955); Compt. rend. 241, 393 (1955).

In_{49} Relative isotopic abundances ms

In^{113} 4.33% 4
In^{115} 95.67%
No In^{108}, In^{109}, In^{110}, In^{111} ($<2 \times 10^{-6}$%)
No In^{112} ($<4 \times 10^{-6}$%)
No In^{114} ($<2 \times 10^{-5}$%)
No In^{116} ($<1 \times 10^{-5}$%)
No In^{117}, In^{118} ($<8 \times 10^{-6}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

γ	In(n,n'γ)	E_n = 0.35 to 3.9 scin
	0.26	
	0.50	1.11
	0.91	1.42

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$In^{107}_{49\ 58}$ 33^m

τ	~30^m	/ Cd^{106}(7.8-Mev d,n) chem
β^+	~2	scin
$\gamma(Cd^{107})$	0.22	scin $\beta\gamma$, scin
β(0.22 γ)		

W.A.Cassatt, Jr., W.W.Meinke, Phys. Rev. 100, 1372 (1955).

$In^{111}_{49\ 62}$ 2.8^d

$\gamma(Cd^{111})$ **(0.172)** E2/M1 = 0.016 $\gamma\gamma(\theta)$
(0.247) E2 = 100%
(0.172 γ)(0.247 γ)(θ) J = 7/2, 5/2, 1/2
$\gamma\gamma(\theta)$, $ce_K\gamma(\theta)$, $\gamma ce_K(\theta)$, $ce_K ce_K(\theta)$

F.Gimmi, E.Heer, P.Scherrer, Helv. Phys. Acta, 29, 147 (1956); 27, 180A (1954); Z. Phys. 138, 394 (1954).

$\gamma(Cd^{111})$ $Ag^{(109)}(\alpha,2n)$ chem; scin
(0.172) E2/M1 = 0.021 *2* $\gamma\gamma(\theta)$
(0.247) E2
(0.172 γ)(0.247 $\gamma\gamma(\theta)$ J = 7/2, 5/2, 1/2
$\eta(\pi)$ = −0.248 *3*
Effect of extranuclear fields on $\gamma\gamma(\theta)$ studied

R.M.Steffen, Phys. Rev. 103, 116 (1956).

(0.172 γ)(0.247 γ)(θ) scin
Effect of ϵ_K on time-dependent angular correlation coefficient shown

P.Lehmann, J.Miller, J.Phys. Radium 17, 526 (1956).

(0.172 γ)(0.247 γ) delay = $84.9^{m\mu s}_{-5}{}^{+13}$ scin

P.C.Simms, R.M.Steffen, Bull. Am. Phys. Soc. 1, No. 4, 207 R5 (1956).

(0.172 γ)(0.247 γ) delay = $85^{m\mu s}$ 2

L.H.Rietjens, H.J.Van den Bold, A.Heyligers, Physica 21, 899 (1955).

$In^{113}_{49\ 64}$ 1.7^h

γ **(0.392)** α = 0.39 *4* GM
Authors conclude γ is E5

I.V.Estulin, E.M.Moiseeva, Soviet Phys. JETP 1, 463 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 541 (1955).

$In^{114}_{49\ 65}$

0.192 level
J 5 M
μ +4.7 5*

L.S.Goodman, S.Wexler, Phys. Rev. 100, 1245A (1955); *verbal report.

$In^{114}_{49\ 65}$ 72^s g.s.

$Cd^{114}(p,n)$, $Cd^{114}(d,2n)$, $50^d In$ source
β^- **0.674** *40* scin $\beta\gamma$
β^+ 0.004% **0.400** *25* scin $\gamma^\pm\gamma^\pm\beta^+$
ϵ_K 1.9% scin x/β in 72^s and 50^d In
$\gamma(Sn^{114})$
0.09% **1.300** *40* scin $\beta\gamma$, scin γ
(0.674 β)(1.30 γ) scin
No (K x ray)(0.556, 0.722γ)
$\epsilon_K(72^s)/\epsilon_K(50^d)$ to 1.278 level in $Cd^{114} \leq 0.02$
x(0.722γ)/x in 72^s and 50^d In

L.Grodzins, H.Motz, Phys. Rev. 102, 761 (1956); 100, 1236A (1955).

$In^{114}_{49\ 65}$ 72^s g.s.

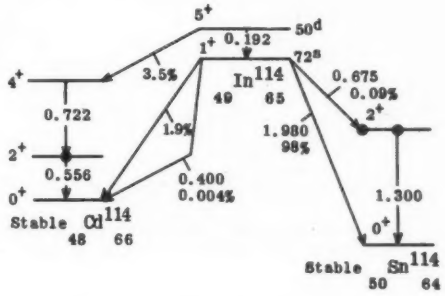
$50^d In^{114}$ source
β^- 0.2% **0.71** *5* scin $\beta\gamma$
$\gamma(Cd^{114})$ **(0.556)**
$\gamma(Sn^{114})$
0.2% **1.299** *2* sd pe
(0.71β)(1.299γ) No (0.556γ)(1.299γ) scin
No 0.576γ (< 0.03%) No 1.271γ (< 0.01%)

M.W.Johns, I.R.Williams, D.E.Brodie, Can. J. Phys. 34, 147 (1956).

$In^{114}_{49\ 65}$ 50^d

$\gamma(In^{114})$ **(0.192)** In^{113}(pile n,γ); scin
$\gamma(Cd^{114})$
100† **0.556**
100† **0.722**
(0.556 γ)(0.722 γ) No 0.572, 1.278γ
No (0.556 γ)(1.30 γ); 1.30γ assigned to $72^s In^{114}$
No (K x ray)(1.30γ)

$In^{114}_{49\ 65}$



L.Grodzins, H.Motz, Phys. Rev. 102, 761 (1956); 100, 1236A (1955).

(0.556 γ)(0.722 $\gamma\gamma(\theta)$) } J = 4^+, 2^+, 0^+ scin
(0.556 γ)(0.722 $\gamma\gamma(\perp)$) }
$\gamma\gamma(\theta)$ found not to be influenced by physical and chemical state of source
No 0.556, 0.722γ in $72^s In^{114}$ scin

J.N.Brazos, R.M.Steffen, Phys. Rev. 102, 753 (1956); R.M.Steffen, L.M.Noble, Bull. Am. Phys. Soc. 1, No. 1, 42, K5 (1956).

Resonances $In^{(113)}(n)$ chopper

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
14.67 *23*	7.5 *8*	**25.0** *5*	10.0 *15*
19.7 *3*		**32.3** *7*	10.2 *22*
21.4 *4*	2.5 *6*	**70.0** *24*	29 *10*

*Assuming $\overline{\Gamma}$ = 80 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$In^{114}_{49\ 65}$? γ $In^{(115)}(\gamma,n\gamma)$ $E_\gamma \leq 22$; scin
0.312 *15* $\gamma\gamma$ delay = 42^{ns} *5*
Threshold = 9.93 *10*

S.H.Vegors, Jr., R.B.Duffield, Bull. Am. Phys. Soc. 1, No. 4, 206 R1 (1956); verbal report.

$In^{115}_{49\ 66}$ **ground state**

μ_3 **0.31** *1*

Calculated using data of P. Kusch, T.G. Eck*

C. Schwartz, Phys. Rev. 97, 380 (1955); *P. Kusch, T.G. Eck, Phys. Rev. 94, 1799 (1954).

$In^{115}_{49\ 66}$ γ **(0.335)** K/LM = 3.75 *15* sl

4.5^h $\omega_K = 0.87$ *3* found from e_{AK}/ce_K

J. Laberrigue-Frolow, P. Radvanyi, Compt. rend. 242, 901 (1956).

γ **(0.335)** $\alpha = 0.90$ *6* GM

Authors conclude γ is E5

I.V. Estulin, E.M. Moiseeva, Soviet Phys. JETP 1, 463 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 541 (1955).

$In^{115}_{49\ 66}$ Levels $In^{(115)}(\gamma,\gamma')4.5^h\ In^{115}$

2† **1.02** E_γ = 1.1 to 2

10† **1.45**

†$\int\sigma dE$ in units of 10^{-33} Mev-cm^2

J.L. Burkhardt, E.J. Winhold, T.H. Dupree, Phys. Rev. 100, 199 (1955).

Level $In^{(115)}(\alpha,\alpha'\gamma)$ E_α = 7 to 20

1.5 scin 0.335 γ

R.R. McLeod Phys. Rev. 100, 1265A (1955).

γ $In^{(115)}(p,p'\gamma)$ $E_p \sim 30$; scin

0.512 *12*

Yield as $f(E_p)$ incompatible with E2 excitation

A.S. Divatia, R.H. Davis, R.D. Moffat, D.A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

$In^{116}_{49\ 67}$ **54^m level** $In^{(115)}$(pile n,γ)

J **5** M

μ **+4.21** *8*

P.B. Nutter, Phil. Mag. 1, 587 (1956).

54^m level

J **5** M

μ **+4.4** *4**

L.S. Goodman, S. Wexler, Phys. Rev. 100, 1796A (1955); *verbal report.

$In^{116}_{49\ 67}$ $\gamma(Sn^{116})$ $In^{(115)}$(slow n,γ)

54^m

	0.137			scin
	0.40	E2/M1 = 24		
	0.80	E2/M1 = 9		
	1.09	E2	**1.48**	E2
	1.27	E2	**2.09**	E2

(1.09 γ)(1.27 γ)(θ) J = 4, 2, 0

(1.48 γ)(1.27 γ)(θ) J = 4, 2, 0

(0.80 γ)(1.27 γ)(θ) J = 2, 2, 0

(0.40 γ)(2.09 γ)(θ) J = 2, 2, 0

R.P. Scharenberg, M.G. Stewart, M.L. Wiedenbeck, Phys. Rev. 101, 689 (1956).

$In^{116}_{49\ 67}$ Resonances $In^{(115)}$(n) chopper

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
9.00 *11*	1.74 *43*		
12.0 *2*	0.116 *10*	**63** *2*	
22.8 *4*	1.35 *19*	**84.2** *30*	13.2 *45*
39.8 *10*	4.1 *8*	**95** *4*	2.2 *9*
47.9 *13*	0.98 *30*	**129** *6*	

*Assuming $\overline{\Gamma}_\gamma$ = 80 mev

J.A. Radkevich, V.V. Vladimirsky, V.V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Sn Level Sn(n,n') E_n = 2.45

50

$\sigma(90°)$	Level	
47 *3*	**1.24** *3*	pulsed n's

σ units: mb/sterad

L. Cranberg, J.S. Levin, Phys. Rev. 103, 343 (1956).

Sn ? γ Sn(γ,? γ) $E_\gamma \leq 22$; scin

50 **0.503** *15* $\gamma\gamma$ delay = 165$^{\mu s}$ *15*

S.H. Vegors, Jr., R.B. Duffield, Bull. Am. Phys. Soc. 1, No. 4, 206 R1 (1956); verbal report.

$Sn^{110}_{50\ 60}$ τ $4.1^{h*}{}_2$ Cd^{108}(32-Mev α,2n) chem

4.1^h $\gamma(In^{110})$ **0.285** scin, sl ce

p $66^m In^{110}$

S.W. Mead, M.D. Petroff, W.O. Doggett, Phys. Rev. 100, 1794A (1955); *verbal report.

$Sn^{113}_{50\ 63}$ τ **130^d** *3* Sn^{112}(pile n,γ)

118^d $\gamma(In^{113})$

12† **0.258** scin

100† **0.393**

G. Gardner, J.I. Hopkins, Phys. Rev. 101, 999 (1956).

$Sn^{113}_{50\ 63}$ 118^d

τ **119^d** *3*

$\epsilon_L/\epsilon_K = 0.17 \pm 0.12$ from $\epsilon_K = 85\%$ *10* GM x/ce

No γ with $0.028 < E_\gamma < 0.10$ ($< 0.03\%$) pc

No ce 0.0858γ (< 0.01 of ce_K 0.392γ) sl

No 0.255γ ($< 1\%$) no 0.401γ ($< 10\%$) scin, sl

P. Avignon, Ann. Phys. 1, 10 (1956); Y. Deschamps, P. Avignon, Compt. rend. 236, 478 (1953).

E_ϵ **0.10** *1* (K x ray)(continuum γ)

R.G. Jung, M.L. Pool, Bull. Am. Phys. Soc. 1, No. 4, 172 E11 (1956).

$Sn^{115}_{50\ 65}$

$Sn^{115}(\alpha, \alpha'\gamma)$ $E_\alpha = 4.5$

No γ observed scin

L.W. Fagg, E.H. Geer, E.A. Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

$Sn^{117}_{50\ 67}$ 14^d

Sn^{116}(pile n, γ)

γ **(0.161)** E2/M1 = 0.0015 (*+15, −10*)

(ce_K 0.159 γ)(0.161 γ)(θ); sl, scin

R.K. Golden, S. Frankel, Phys. Rev. 102, 1053 (1956); 95, 613A (1954).

$Sn^{117}_{50\ 67}$

$Sn^{117}(\alpha, \alpha'\gamma)$ $E_\alpha = 4.5$

No γ observed scin

L.W. Fagg, E.H. Geer, E.A. Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

$Sn^{119}_{50\ 69}$

$Sn^{119}(\alpha, \alpha'\gamma)$ $E_\alpha = 4.5$

No γ observed scin

L.W. Fagg, E.H. Geer, E.A. Wolicki, Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956); verbal report.

$Sn^{127}_{50\ 77}$ 2.0^h

$Te^{(130)}(n, \alpha)$ chem

τ **2.05^h** *5* p 4^dSb

H. Carminatti, I. Fraenz, R. Radicella, J. Rodriguez, Z. Naturf. 11a, 419 (1956).

$Sn^{130}_{50\ 80}$? 2.6^m

τ **2.6^m** *3* U(n, f) chem

From milking of 10^mSb

A.C. Pappas, D.R. Wiles, J. Inorg. Nuclear Chem. 2, 69 (1956).

$Sn^{131}_{50\ 81}$ 3.4^m

τ **3.4^m** *5* U(n, f) chem

From milking of 23^mSb

A.C. Pappas, D.R. Wiles, J. Inorg. Nuclear Chem. 2, 69 (1956).

$Sn^{132}_{50\ 82}$ 2.2^m

τ **2.2^m** *3* U(n, f) chem

From milking of 2.1^mSb

A.C. Pappas, D.R. Wiles, J. Inorg. Nuclear Chem. 2, 69 (1956).

Sb_{51}

γ $Sb(n, n'\gamma)$ $E_n = 3.7$; scin

1.00 *4* $\sigma(90°) = 75$ mb/sterad

M.A. Rothman, H.S. Hans, C.E. Mandeville, Phys. Rev. 100, 83 (1955).

$Sb^{116}_{51\ 65}$ 15.5^m g.s.

β^+ **2.3** *3* a

A.H.W. Aten, Jr., Physica 22, 288 (1956); 20, 665 (1954).

$Sb^{119}_{51\ 68}$ 39^h

τ **38.0^h** d $4.5^d$$Te^{119}$ chem

ϵ **0.563** *10* scin γ continuum

$\gamma(Sn^{119})$ **0.02383*** *3* $\alpha = 6.3$ *4* sπ ce

$L_1/L_2L_3 > 3$* M1

(K x ray)(0.024γ) delay = $18.5^{m\mu s}$

J.L. Olsen, L.G. Mann, M. Lindner, Bull. Am. Phys. Soc. 1, No. 1, 41, K2 (1956); *J.M. Hollander, ibid.

$Sb^{122}_{51\ 71}$ 2.75^d g.s.

$\gamma(Te^{122})$ **0.56393** *19* cryst

N. Ryde, B. Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

$\beta(0.57\gamma)$ delay = $150^{\mu\mu s}$ *20* scin

C.F. Coleman, Phil. Mag. 46, 1135 (1955).

$Sb^{122}_{51\ 71}$

Resonances Sb^{121}(n) chopper

σ_o (10^3b)	E_o(ev)	Γ(mev)	Γ_n(mev)
10.8†	6.25	62†	3.2†
11.9	15.6	70	10.0
5.2	29.8	68	8.2
1.4	53.5	64	3.7
0.36	64.0	61	1.1
2.9	74.0	72	11.9
5.8	90	102	41

For 6.25 ev resonance, $\Gamma_\gamma = 60 \pm 20$ mev

For other resonances $\Gamma_\gamma = 60$ mev was assumed

Values assuming $\Gamma_\gamma = 100$ mev are also given

R.R. Palmer, L.M. Bollinger, Phys. Rev. 102, 228 (1956).

$Sb^{124}_{51\ 73}$ τ **53.7^d** *8* differential ic

54^d g.s.

B.S.Dzhelepov, O.E.Kraft, Vestnik-Leningrad Univ., Ser. Mat. Fiz. Khim. No. 8, 97 (1955); Chem. Abstr. 50, No. 12675e (1956).

$\gamma(Te^{124})$				
1270†	**(0.603)**	40†	**1.052**	sπ Cp
	(0.650)	147†	**1.347**	
259†	**(0.714)**	1000†	**(1.708)**	
64†	**0.958**	130†	**(2.062)**	

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956); Doklady Akad. Nauk SSSR 86, 255 (1952).

$Sb^{124}_{51\ 73}$ Resonances $Sb^{123}(n)$ chopper

$\sigma_o(10^3b)$	E_o(ev)	Γ(mev)	Γ_n(mev)
21.00	**21.6**	92	32
2.48	**50.5**	66	6.5
4.35	**76.5**	80	20
6.70	**105**	131	71

Assuming Γ_γ= 60 mev
Values assuming Γ_γ= 100 mev are also given

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Sb^{125}_{51\ 74}$ $Sn^{(124)}$(pile n,$\gamma\beta$) chem

2.0^y τ **2.0^y** *2*

$\gamma(Te^{125})$				
1.4†	**0.113**			scin γ
19†	**0.175**			
0.6†	**0.175**			scin $\gamma\gamma$
0.8†	**0.205**			
0.6†	**0.214**			
0.88†	**0.320**			
3.8†	**0.377**			scin γ
100†	**0.427**	88†	**0.595**	
31†	**0.463**	23†	**0.637**	

(K x ray)(0.427, 0.595γ)
(0.133 γ)(0.2, 0.37 γ)
(0.175 γ)(0.113, 0.205, 0.320 γ)
(0.427 γ)(0.175, 0.214 γ)
(0.463 γ)(0.175, 0.214 γ)
No 0.140, 0.342 γ

N.H.Lazar, Phys. Rev. 102, 1058 (1956).

$Sb^{127}_{51\ 76}$ $Te^{(128)}(\gamma,p)$ chem; $E_\gamma \leq 70$

93^h

β^-						
	50%	**0.86** *2*				scin
	20%	**1.11** *3*				
	30%	**1.57** *3*				
$\gamma(Te^{127})$		**0.058** *10*	st	**0.456** *4*		scin
		0.185 *8*		**0.563** *5*		
	st	**0.240** *3*	st	**0.674** *5*		
		0.417 *8*		**0.764** *10*		

(0.86 β)(0.674 γ) (1.11 β)(0.456 γ)

M.C.Day,Jr., A.F.Voigt, Phys. Rev. 101, 1784 (1956).

$Sb^{129}_{51\ 78}$ $Te^{(130)}(\gamma,p)$ chem; E_γ = 70

4.6^h

β^-	20%	**1.87** *5**			scin
$\gamma(Te^{129})$		**0.165** *5*		**0.534** *3*	scin
		0.308 *4*		**0.788** *5*	

*Also other β^- groups with E_β < 1.87

M.C.Day,Jr., A.F.Voigt, Phys. Rev. 101, 1784 (1956).

$Sb^{130}_{51\ 79}$? τ **9.2^m** *3* d 2.6^mSn chem

10^m

A.C.Pappas, D.R.Wiles, J. Inorg. Nuclear Chem. 2, 69 (1956).

$Sb^{132}_{51\ 81}$ τ **2.1^m** *2* d 2.2^mSn chem

2.1^m

A.C.Pappas, D.R.Wiles, J. Inorg. Nuclear Chem. 2, 69 (1956).

Te 52 Level Te(n,n') E_n = 2.45

σ(90°)	Level	pulsed n's
55 *6*	**0.72** *5*	σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

$Te^{120}_{52\ 68}$ Level $Te^{120}(\alpha,\alpha'\gamma)$ E_α = 6.5

γ **0.560** $\tau = 9.4^{\mu\mu s}$ scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Te^{121}_{52\ 69}$ γ $Sb^{(121)}$(15-Mev d,2n) chem

154^d

0.0818 sl ce
0.214 E2/M1 = 0.059 scin,sl ce
(ce_K 0.082 γ)(0.214 γ)(θ) sl ce,
(ce_L 0.082 γ)(0.214 γ)(θ) scin
(ce_K 0.082 γ)(ce_K 0.214 γ)(θ)
Results compatible with J = 11/2, 3/2, 1/2

N.Goldberg, S.Frankel, Phys. Rev. 100, 1350 (1955); 93, 1425 (1954).

γ **(0.214)** α_K = 0.072 *3* sl ce
K/L = 6.3 *3*

N.Goldberg, Bull. Am. Phys. Soc. 1, No. 4, 207 R7 (1956).

$Te^{122}_{52\ 70}$ Level $Te^{122}(\alpha,\alpha'\gamma)$ E_α = 6.5

γ **0.570** $\tau = 10^{\mu\mu s}$ scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Te^{123}_{52\ 71}$ 104^{d}

γ	$Sb^{(123)}$(15-Mev d,2n) chem		
	0.0887		sl ce
	0.159	E2/M1 = 0.013	scin,sl ce
	$(ce_K\ 0.089\gamma)(0.159\gamma)(\theta)$		sl ce,
	$(ce_L\ 0.089\gamma)(0.159\gamma)(\theta)$		scin
	$(ce_K\ 0.089\gamma)(ce_K\ 0.159\gamma)(\theta)$		

Results compatible with J = 11/2, 3/2, 1/2

N.Goldberg, S.Frankel, Phys. Rev. 100, 1350 (1955); 93, 1425 (1954).

γ	**(0.159)**	α_K = 0.165 *5*	sl ce
		K/L = 6.6 *3*	

N.Goldberg, Bull. Am. Phys. Soc. 1, No. 4, 207 R7 (1956).

$Te^{123}_{52\ 71}$ Levels $Te^{123}(p,p'\gamma)$ E_p = 3.7; scin

$Te^{123}(\alpha,\alpha'\gamma)$ E_α = 4.0; scin

0.159 level		0.436 level		0.504 level	
γ	**0.159** *2*	γ	**0.159** *2*	γ	**0.159** *2*
	0.274 *3*		**0.274** *3*		**0.342** *3*
	0.436 *5*				**0.504** *5*

$(0.274\gamma)(0.159\gamma)$ $(0.342\gamma)(0.159\gamma)$

No $(0.274\gamma)(0.342\gamma)$ No 0.068γ

L.W.Fagg, E.A.Wolicki, R.O.Bondelid, K.L. Dunning, S.Snyder, Phys. Rev. 100, 1299; 98, 1538A (1955).

$Te^{124}_{52\ 72}$ Level $Te^{124}(\alpha,\alpha'\gamma)$ E_α = 6.5

γ	**0.608**	$\tau = 8.8^{\mu\mu s}$	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

Capture γ	$Te^{(123)}(n,\gamma)$		E_n = 2.33 ev
~30†	**(0.600)**		scin

†Photons/100 Te^{123} captures

R.G.Bennett, A.E.Walters, C.A.Fenstermacher, L.Rosler, Bull. Am. Phys. Soc. 1, No. 1, 62, UA5 (1956).

$Te^{125}_{52\ 73}$ $Te^{125}(n,n'\gamma)$ E_n = 4.4

No γ observed scin

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No.1, 42 K3 (1956).

γ	$Te^{125}(p,p'\gamma)$		E_p = 3.0
0.435	B(E2) = 0.44*		scin
0.633	= 0.26$		

Assuming γ cascade from level at *0.47, $0.67

L.W.Fagg, E.A.Wolicki, R.O.Bondelid, K.L. Dunning, S.Snyder, Phys. Rev. 100, 1299; 98, 1538A (1955).

Level $Te^{126}(\alpha,\alpha'\gamma)$ E_α = 6.5

γ	**0.662**	$\tau = 7.0^{\mu\mu s}$	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Te^{126}_{52\ 74}$ γ $Te^{126}(n,n'\gamma)$ E_n = 4.4

60†	**0.68** *2*		scin
20†	**1.38** *4*		

No 0.74γ (<0.03†)

†Photons/100 0.83γ's from $Te^{130}(n,n'\gamma)$

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Te^{127}_{52\ 75}$ 9.4^{h} g.s.

τ	**9.35**^{h} *2*		d 93^{h}Sb from U(n,f), $Te^{126}(n,\gamma)$ chem
β^-	**0.695** *10*		sl
$\gamma(I^{127})$ 6†	**0.0585** *1*	α = 1.95*	sl,scin
0.8†	**0.145** *2*		scin $\gamma\gamma$
11†	**(0.203** *3*)		scin
	(0.215 *4*)		
15†	**0.360** *4*		
100†	**0.418** *2*		

$0.418\gamma/100\beta = 0.8$ *1* No 0.170γ (<0.32†)

(0.360γ)(K x ray, 0.059γ)

$(0.059\gamma)(0.155^{\$}, 0.208, 0.360\gamma)$

$(0.208\gamma)(0.145, 0.208\gamma)$

*Using α = 0.025, 0.4 for 0.360γ, 0.145γ resp.

$From overlap of 0.145$\gamma$ and Cp peak of 0.360γ

J.D.Knight, J.P.Mize, J.W.Starner, J.W.Barnes, Phys. Rev. 102, 1592 (1956).

			$Te^{(128)}(\gamma,n)$ chem
β^-	**0.683** *10*		scin

No γ

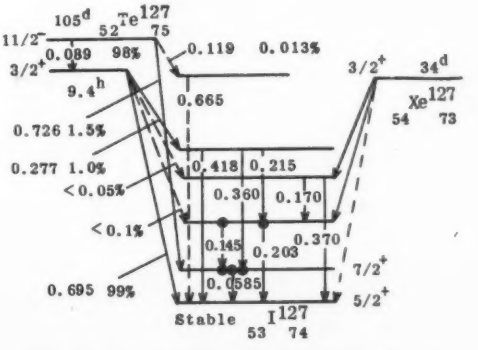
M.C. Day, Jr., G.W. Eakins, A.F. Voigt, Phys. Rev. 100, 796 (1955).

β^-	**0.72** *5*	F-K linear	sπ ppl

P.Kleinheins, Z. Naturf. 11a, 252 (1956).

$Te^{127}_{52\ 75}$ 105^{d}

τ	**105**^{d} *2*		d 93^{h}Sb from U(n,f), $Te^{126}(n,\gamma\beta)$ chem
$\gamma(Te^{127})$ 13†	**0.089** *2*		scin
$\gamma(I^{127})$ 66†	**0.0585** *10*		
1.7†	**0.665** *5*		
x	**K x ray**		



J.D.Knight, J.P.Mize, J.W.Starner, J.W. Barnes, Phys. Rev. 102, 1592 (1956).

$Te^{128}_{52\ 76}$

Level	$Te^{128}(n,n'\gamma)$	$E_n = 4.4$
γ	70† **0.76** 2	scin

†Photons/100 0.83γ's from $Te^{130}(n,n'\gamma)$

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42, K3 (1956).

Level	$Te^{128}(\alpha,\alpha'\gamma)$	$E_\alpha = 6.5$
γ	**0.750** $\tau = 4.2^{\mu\mu s}$	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Te^{129}_{52\ 77}$ 74^m g.s.

		74^m	Te^{128}(11.5-Mev d,p)	chem
τ		**74**^{m}		
β^-	10%	**0.29** 6	15% **0.989** 20	sl
	4%	**0.69** 10	71% **1.453** 5	
$\gamma(I^{129})$		**0.0268**		scin, sl ce
		0.475 5		scin
		~**0.77**		
		1.12 2		
ce 0.0268γ/β~0.23				sl

W.E.Graves, A.C.G.Mitchell, Phys. Rev. 101, 701 (1956); 100, 1236A (1955).

		$Te^{(130)}(\gamma,n)$	chem
β^-	~20%	**1.01** 2	scin $\beta\gamma$
	~80%	**1.46** 1	scin
$\gamma(I^{129})$		~**0.035**	
		0.450 5	
(1.46β)(~0.035γ)		(1.01β)(0.45γ)	
(~0.035γ)(0.45γ)		No 0.485γ	

M.C. Day, Jr., G.W. Eakins, A.F. Voigt, Phys. Rev. 100, 796 (1955).

$\gamma(I^{129})$	10†	**0.460** 10	scin
	w	**0.775*** 20	
	1†	**1.070** 20	

No γ with $0.15 < E_\gamma < 0.45$

*Assignment uncertain

T.Stribel, Z. Naturf. 10a, 797 (1955).

$Te^{129}_{52\ 77}$ 41^d+ 74^m

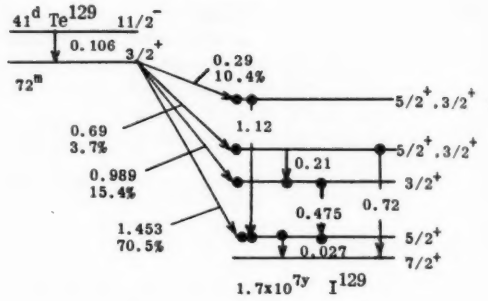
		41^d	Te^{128}(11.5-Mev d,p)	chem
τ		**41**^{d}		
β^-	13%	**0.35** 6	16% **0.972** 20	sl
	3%	**0.66** 10	68% **1.530** 5	
$\gamma(Te^{129})$		**0.1063** 1		s ce
$\gamma(I^{129})$		**0.0268**		scin, sl ce
		0.21 1	**0.72** 1	scin
		0.475 5	**1.14** 2	
(0.35β)(1.14γ)		(0.66β)(0.72γ)		scin
(0.97β)(0.475γ)		(1.5β)(0.027γ)*		
(0.027γ)(0.475, 1.14γ)		(0.21γ)(0.475γ)		
Ce 0.106γ/β = 0.95				sl

*F-K end point gave $E_\beta = 1.45$

Continued

$Te^{129}_{52\ 77}$

Continued



W.E.Graves, A.C.G.Mitchell, Phys. Rev. 101, 701 (1956); 100, 1236A (1955).

$Te^{130}_{52\ 78}$

Level	$Te^{130}(n,n'\gamma)$	$E_n = 4.4$
γ	st **0.83**	scin

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42, K3 (1956).

Level	$Te^{130}(\alpha,\alpha'\gamma)$	$E_\alpha = 6.5$
γ	**0.850** $\tau = 2.4^{\mu\mu s}$	scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Te^{132}_{52\ 80}$ 78^h

τ	**75**^{h} 3	U(n,f), Pu(n,f)
		Xe^{132}/Xe^{134} as f(t),ms

W.H.Fleming, H.G.Thode, Can. J.Chem. 34, 408 (1956).

I_{53}

Relative isotopic abundance

No I^{129} ($< 10^{-6}$%) from absence of 12.5^h I^{130} after neutron irradiation of iodine

B.C.Purkayastha, G.R.Martin, Can. J. Chem. 34, 293 (1956).

$I^{127}_{53\ 74}$

ground state

$|\mu_3|$ **0.17** 3

Recalculated using data of V.Jaccarino et al.*

C.Schwartz, Phys. Rev. 97, 380 (1955); *V. Jaccarino et al., Phys. Rev. 94, 1798 (1954).

$I^{127}_{53\ 74}$

γ	$I^{127}(\alpha,\alpha'\gamma)$		scin
	0.060 *2*		
	0.201 *4*		

γ	$I^{127}(p,p'\gamma)$	E_p=3.20; scin	
0.208 *7*	B(E2) = 0.044	(α = 0.14)	
0.392* *8*			
0.438 *10*	B(E2) = 0.0061		
0.631 *10*	= 0.116		
0.751 *25*	= 0.074		
0.94* *5*			

*Yield as f(E_p) incompatible with E2 excitation

A.S.Divatia, R.H.Davis, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

γ	$I^{127}(n,n'\gamma)$		E_n = 0.80
			scin
0.134 *20*			
0.21 *2*		**0.62** *2*	
0.42 *2*		**0.78** *2*	

I.L.Morgan, Phys. Rev. 103, 1031 (1956).

γ	$I^{127}(n,n'\gamma)$		E_n = 2.5
~**0.2**		**0.64** *5*	scin
~**0.41**		**1.01** *5*	

E.Wolf, Phil. Mag. 1, 102 (1956).

$I^{128}_{53\ 75\ 25^m}$

					I^{127}(slow n,γ) chem
β^-	2.0%	**1.125** *20*			1.665β - 0.540γ, sl
	15.5%	**1.665** *15*			sl
	76.0%	**2.120** *10*			
No β^+					sl, scin
$\gamma(Te^{128})$					
	0.31%	**0.750** *7*			scin
$\gamma(Xe^{128})$					
	17.2%	**0.455** *5*			scin
	1.8%	**0.540** *5*	0.29%	**0.990** *10*	
$\beta^-/0.455\gamma$ = 5.0 ± 0.5					sl, scin
$\epsilon_K/0.455\gamma$ = 0.316		Te K x ray/0.455γ			pc, scin
Total ϵ decay is 6.4% assuming ϵ_L/ϵ_K = 0.1					
(0.455γ)(0.540γ)					scin
(0.750γ)(Te x rays)					

N.Benczer, B.Farrelly, L.Koerts, C.S.Wu, Phys. Rev. 101, 1027 (1956); 100, 955A (1955)

β^-	~**1.6**		scin$\beta\gamma$
	~**2.0**		scin
$\gamma(Xe^{128})$	**0.428**		
(~1.6β)(0.428γ)			

T.Stribel, Z. Naturf. 10a, 797 (1955).

$\gamma(Xe^{128})$*		I^{127}(n,γ) chem; scin
100†	**0.440** *5*	
<1.5†	**0.520**	
3†	**0.960** *15*	
$\gamma(Te^{128})$*		
~0.5†	**0.750**	

*Assignment from energy systematics of 2^+ states

R.K. Gupta, S.Jha, Nuclear Phys. 1, 2 (1956).

$I^{128}_{53\ 75}$

Capture γ's	I^{127}(th n,γ)		
st	~**0.085**		scin Cp
w	**0.255**		

Study covered E_γ = 0.1 to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

Resonances E_o(ev)	Γ_n(mev)*	I^{127}(n) E_o(ev)	Γ_n(mev)*	chopper Γ_n(mev)*
20.5 *4*	1.08 *24*			
31.4 *6*	15 *3*	**66** *2*	14.5 *65*	
38.1 *9*	36 *7*	**79** *3*	37 *16*	
46.0 *12*	21 *6*	**92** *4*	21 *11*	

*Assuming Γ_γ = 100 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$I^{131}_{53\ 78}$ 8.05^d

$\gamma(Xe^{131})$	**0.08016**	L_1/L_2~10	sπ ce
	0.1638 *1*		
	0.1771 *1*		

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 746 (1956).

Xe 54

Relative isotopic abundances ms
No Xe^{119}, Xe^{120}, Xe^{121}, Xe^{122}, Xe^{123} ($< 10^{-6}$%)
No Xe^{125}, Xe^{127}, Xe^{138}, Xe^{140}, Xe^{141} ($< 2 \times 10^{-6}$%)
No Xe^{133}, Xe^{135} ($< 6 \times 10^{-6}$%)
No Xe^{137}, Xe^{139} ($< 3 \times 10^{-6}$%)

D.C.Hess, ANL-5420 (1956).

$Xe^{130}_{54\ 76}$

Level	$Xe^{(130)}(\alpha,\alpha'\gamma)$		E_α = 6.5
γ	**0.530**		scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3$_9$ (1956); verbal report.

$Xe^{131}_{54\ 77\ 12^d}$

Charges 1 to 21 (av.= 8.0) found on recoils
Charge distribution given s Xe^{131} recoil

A.H.Snell, F.Pleasonton, Bull. Am. Phys. Soc. 1, No. 1, 42, K6 (1956); verbal report.

$Xe^{131}_{54\ 77}$

γ	$Xe^{(131)}(\alpha,\alpha'\gamma)$		E_α = 6.5
	0.286		scin
	0.364		

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Xe^{132}_{54\ 78}$

Level	$Xe^{(132)}(\alpha,\alpha'\gamma)$		E_α = 6.5
γ	**0.670**		scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Xe^{134}_{54\ 80}$ Level $Xe^{(134)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$

γ **0.870** scin

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$Xe^{136}_{54\ 82}$ Resonance $Xe^{135}(n)$ $E_n = 0.015$ to 0.20 ev

0.085 ev $\Gamma_n = 0.031$ cryst

$\Gamma_\gamma = 0.083$ for g = 3/8

σ_t(peak) = 3.3×10^4 $\Gamma_n = 0.018$

$\Gamma_\gamma = 0.094$ for g = 5/8

S.Bernstein, M.M.Shapiro, C.P.Stanford, T.E. Stephenson, J.B.Dial, S.Freed, G.W.Parker, A.R.Brosi, G.M.Hebert, T.W.DeWitt, Phys. Rev. 102, 823 (1956).

Cs_{55} Relative isotopic abundances ms

Cs^{133} **100.0%**

No Cs^{130} ($< 2 \times 10^{-6}$%) No Cs^{134} ($< 5 \times 10^{-5}$%)

No Cs^{131}, Cs^{136} ($< 1 \times 10^{-5}$%)

No Cs^{132}, Cs^{135} ($< 3 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$Cs^{128}_{55\ 73}$ 3.8^m τ **2.5**^{m} *1* La(480-Mev p) chem

β^+ **2.9**

d Ba^{128}

A.N.Murin, B.K.Preobrazhensky, I.A. Yutlandov, M.A.Yakimov, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 160 July (1955); Consultants Bureau Trans. p. 101.

$Cs^{129}_{55\ 74}$ 31^h $\gamma(Xe^{129})$ Cs^{133}(80-Mev p,p4n) chem

0.395 *10* scin

0.55 *3*

B.L.Robinson, R.W.Fink, Phys. Rev. 98, 221, 231A (1955).

$Cs^{131}_{55\ 76}$ 10^d Continuous γ spectrum in coincidence with K x rays has shape predicted by Morrison and Schiff for $E_\gamma > 0.05$

A.Michalowicz, Compt. rend. 242, 108 (1956).

$Cs^{134}_{55\ 79}$ 2.3^y g.s.

β^-	28%	**0.080** *3*				sl
	3%	**0.210** *10*	56%	**0.650** *5*		
	5%	**0.409** *44*	8%	**0.685** *10*		
$\gamma(Ba^{134})$	10†	**0.204** *5*				sl ce,pe
	4†	**0.475** *3*	72†	**0.796** *1*		
	14†	**0.562** *2*	11†	**0.802** *1*		
	12†	**0.569** *1*	5†	**1.035** *3*		
	100†	**0.604** *1*	3†	**1.167** *3*		
	w	**0.658** *3**	5†	**1.369** *3*		

*Due to Cs^{137} impurity?

H.H.Forster, J.S.Wiggins, Nuovo Cim. 2, 854 (1955).

$Cs^{134}_{55\ 79}$ 2.3^y g.s. Cs^{133}(slow n,γ)

$\gamma(Ba^{134})$ w	~**0.21**				scin
<1†	**0.475** *3*	100†	**0.603** *1*		
19†	**0.566** *4*	96†	**0.797** *2*		

K.E.Johansson, Arkiv Fysik 10, 247 (1956).

$\gamma(Ba^{134})$

	α	
(0.569)	0.0092	*12*
(0.605)	0.0053	*5*
(0.796)	0.0024	*3*
(1.367)	0.00049	*5*

sl ce,Cp

Z.O'Friel, A.H.Weber, Phys. Rev. 101, 1076 (1956).

(1.367 γ)(0.605 γ)(θ) J = 3(or 4 or 2), 2, 0

E.D.Klema, Phys. Rev. 100, 66 (1955).

No 1.451β^- ($< 5 \times 10^{-3}$%) sl

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

$Cs^{137}_{55\ 82}$ 27^y τ $30.0^{y\ +3}_{\ -4}$ specific activity; 4π ic, ms

F.Brown, G.R.Hall, A.J.Walter, J. Inorg. Nuclear Chem. 1, 241 (1955).

$Cs^{138}_{55\ 83}$ 32^m τ **32.2**^{m} *1* $U^{(235)}$(n,f) chem

R.M.Bartholomew, A.P.Berg, Can. J.Chem. 34, 201 (1956).

$\gamma(Ba^{138})$ $U^{(235)}$(th n,f) chem

2%	**0.1389**	M1*	4%	**0.87**	scin,
1%	**0.1931**		25%	**1.010**	sπ ce
2%	**0.2289**		73%	**1.426**	
3%	**0.4106**		18%	**2.21**	
26%	**0.4626**		9%	**2.63**	
8%	**0.5495**		0.5%	**3.34**	

(1.426 γ)(0.139, 0.411, 0.463, 0.550, 0.87 γ, 1.010 γ) No (1.426 γ)(2.21, 2.63 γ)

(0.229 γ)(2.21 γ) No (0.229 γ)(2.63 γ)

(0.463 γ)(0.139, 0.411, 0.550 γ)

No (0.463 γ)(1.010 γ) (0.139 γ)(0.87 γ)

(1.010 γ)(1.426 γ)(θ) J = 3, 2, 0

*M1 assignment based on α

R.B.Duffield, M.E.Bunker, J.P.Mize, J.W. Starner, Phys. Rev. 100, 1236A (1955); verbal report.

Ba 56

Ba(n) E_n = 15 to 102 kev, Li(p,n)

Graph given showing 5 weak resonances

H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williamson, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956).

Ba^{131} 56 75 11.5^d

τ **11.52^d** *8* $Ba^{(130)}$(n,γ) chem

$\gamma(Cs^{131})$	**0.083***	360†	**0.496***	scin
200†	**0.122**	33†	**0.620**	
150†	**0.214**	2†	**0.823** *20*	
	0.244 ?	7†	**0.917** *15*	
100†	**0.372**	11†	**1.032** *15*	

(0.496 γ)(0.122 γ) Σ scin

No 0.100, 0.196, 0.585 γ's

0.823, 0.917, 1.032 γ's are not crossovers

*Two or more unresolved γ's

W.C.Beggs, B.L.Robinson, R.W.Fink, Phys. Rev. 101, 149 (1956).

$\gamma(Cs^{131})$ $Ba^{(130)}$(pile n,γ) chem

100†	**(0.496)**	scin
4†	**1.050** *15*	

R.K.Gupta, S.Jha, Proc. Phys. Soc. 69A, 70 (1956).

$Ba^{(130)}$(pile n,γ) chem

(0.495 γ)(0.122 γ) delay = $4.0^{m\mu s}$ *3*

H.Vartapétian, L.Dick, R.Foucher, N.Perrin, Compt. rend. 242, 103 (1956).

(0.495 γ)(0.122 γ) delay = $4.1^{m\mu s}$ *5*

C.F.Coleman, Phil. Mag. 96, 1135 (1955).

Ba^{133} 56 77 10^y g.s.

$\gamma(Cs^{133})$ Cs^{133}(6.7-Mev d,2n) chem

6†	**0.070** 2	α_K = 2.4* *4*	crit a	scin
		α = 3.0$^\$$ *2*		γ/0.292γ
32†	**0.081** *1*	α_K = 1.75 *5*		$x\gamma/\gamma\gamma$
		α = 1.95 *10*		γ/(0.292 + 0.360 γ)
26†	**0.292** *4*			scin
74†	**0.360** *2*			

[1](0.292 γ)(K x ray, 0.070, 0.081 γ)

[2](0.360 γ)(K x ray, 0.081 γ)

No (0.362 γ)(0.071, 0.292 γ)

Intensity of K x rays due to α_K only

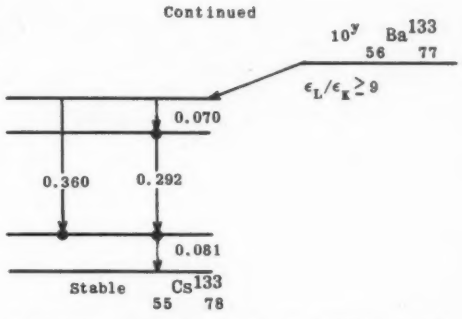
*From difference of γx oetween ([1]) and ([2])

$^\$$Assuming no ϵ to 0.373 level

Continued

Ba^{133} 56 77 10^y g.s.

Continued



M.Langevin, Ann. Phys. 1, 57 (1956); Compt. rend 238, 1310 (1954); 240, 289 (1955).

Ba^{135} 56 79

ground state enriched Ba^{135}

μ **+0.832293** *25* I

$\nu(Ba^{135})/\nu(Cl^{35})$ = 1.01387 *2*

H.E.Walchli, T.J.Rowland, Phys. Rev. 102, 1334 (1956).

Ba^{137} 56 81

ground state enriched Ba^{137}

μ **+0.931074** *55* I

$\nu(Ba^{137})/\nu(Cl^{35})$ = 1.13420 *5*

H.E.Walchli, T.J.Rowland, Phys. Rev. 102, 1334 (1956).

Levels $Ba^{(137)}$(n,n'γ) $2.6^m Ba^{137}$

0.66	E_n = 0.5 to 3
1.05	**2.25** ?*
1.78	**2.38**

*Does not feed IT state, other levels do

C.P.Swann, F.R.Metzger, Phys. Rev. 100, 1329 (1955).

Ba^{139} 56 83

Levels $Ba^{(138)}$(d,p) E_d = 7.0, 7.5

1†	g.s.	Q = 2.493 *10*	s 90°
1.5†	**0.623** *8*		

†Relative intensity for E_d = 7.0

C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955).

Ba^{140} 56 84 13^d

$\gamma(La^{140})$	**(0.030)**	**0.304**	scin
	~**0.132**	**0.436**	
	0.162	**0.537**	

(0.030 γ)(0.436 γ) (0.304 γ)(0.162 γ) Σ scin

(~0.132 γ)(0.304 γ) No γ(0.537 γ)

(0.304 γ)(0.162 γ)(θ) consistent with J = 1,3,4

$W(\theta) = 1 + (0.0937\ 8)P_2(\cos\theta) - (0.056\ 10)\ P_4(\cos\theta)$

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

$_{57}La$ Relative isotopic abundances ms

La^{138} **0.089%** *1.5*

La^{139} **99.911%** *1.5*

No La^{134}, La^{135}, La^{136} ($< 7 \times 10^{-6}$%)

No La^{137} ($< 14 \times 10^{-6}$%) No La^{140} (< 0.001%)

No La^{141} (< 0.002%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$_{57}La^{137}_{80}$ $\sim 6 \times 10^{4}$y

τ_{ϵ_K} **6×10^{4}y** *2* $Ce^{(136)}(n,\gamma\epsilon)$ chem

x **Ba K x ray** specific activity pc, crit a

$E_{dis} >> 0.040$

from $[(x_L/x_K)La^{137}]/[(x_L/x_K)Ce^{139}] \sim 0.5$

A.R.Brosi, B.H.Ketelle, Phys. Rev. 103, 917 (1956).

τ **$>10^{5}$y** d 8.7^hCe

From absence of Ba K,L x rays crit a, pc

A.R.Brosi, B.H.Ketelle, Phys. Rev. 100, 169 (1955).

$_{57}La^{138}_{81}$ 2×10^{11}y

τ_{ϵ_K} **3.2×10^{11}y** *7* natural La chem; pc

0.23 K x rays/sec g La

$\epsilon_L/\epsilon_K \leq 0.5$ (L x rays not observed)

H.Selig, Thesis, Carnegie Inst. Tech. (1954); NYO-6626 (1954).

natural La

$\gamma(Ce^{138})$ **0.81** *1* 0.36**3* γ's/sec g scin

$\gamma(Ba^{138})$ **1.43** *1* 0.41 *3* γ's/sec g

x **K x ray** 0.145 *10* K x rays/sec g

(K x ray)(1.43γ) No 0.535γ

No (K x ray)(0.81γ)

$E_{dis} = 0.160$ *30* from $\epsilon_L/\epsilon_K = 1.4$ *3*, used $\omega_K = 0.85$

*Assumed 3.4 *1* γ's/sec g K

W.Turchinetz, R.W.Pringle, Phys. Rev. 103, 1000 (1956).

$_{57}La^{139}_{82}$

ground state

q **+0.3** *1* S

G.Lührs, Z. Phys. 191, 486 (1955).

ground state

q **+0.6** *2* S

K.Murakawa, J. Phys. Soc. Japan 10, 927 (1955); Phys. Rev. 98, 1285 (1955).

$La^{(139)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

No γ with $E_\gamma < 0.6$; 0.166 level not E2 excited

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

$_{57}La^{140}_{83}$ 40^h

$\gamma(Ce^{140})$

159†	**(0.329)**	114†	**(0.926)**	sπ Cp
370†	**(0.486)**	1000†	**(1.597)**	
350†	**(0.816)**	59†	**2.535**	

B.S.Dzelepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956).

(0.328 γ)(1.60 γ)(θ) scin

(0.328 γ)(0.49 γ)(θ)

(0.815 γ)(1.60 γ)(θ)

(0.490 γ)(1.60 γ)(θ)

Consistent with J = 3, 4, 2, 0 for Ce^{140} levels at 2.42, 2.09, 1.60, g.s.

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

$_{58}Ce$ $Ce(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

No γ with $E_\gamma < 0.6$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

Resonance Ce(n) $E_n = 5$ to 60 kev,

peak **24** kev $l_n = 0$ Li(p,n)

Assigned to Ce^{141}

Graph given showing 11 more peaks

H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williamson, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956); 94, 774A (1954).

$_{58}Ce^{134}_{76}$ 72^h

τ **66^h** U(480-Mev p) chem

A.P.Vinogradov, I.P.Alimarin, V.I. Baranov, A.K.Lavrukhina, T.V.Baranova, F.I.Pavlotskaya, A.A.Bragina, Y.V. Yakovlev, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 97 July (1955); Consultants Bureau Trans. p. 65.

$_{58}Ce^{137}_{79}$ 8.7^h g.s.

τ **8.7^h** Ce^{136}(slow n,γ) chem

ϵ 100% **La K x ray** crit a, pc

$\gamma(La^{137})$ **0.010** $\alpha \sim 140$ sl ce, pc x/γ

3%* **0.445** $\alpha_K \sim 0.02$ scin

(0.445 γ)(0.010γ) delay $< 0.1^{\mu s}$ scin, pc

(La K x ray)(0.010, 0.445γ) crit a, pc

d 35^hCe

*From 0.445γ/(0.255γ of $35^h Ce^{137}$)

A.R.Brosi, B.H.Ketelle, Phys. Rev. 103, 917 (1956); 100, 169 (1955).

τ **9^h** d 1.5^hPr

ϵ 100%

$\gamma(La^{137})$

2.3% **0.440** No 0.254γ

G.T.Danby, A.L.Thompson, J.S.Foster, Proc. Roy. Soc. Canada 50, 27A (1956).

$Ce^{137}_{58\ 79}$ 35^h

τ	34.5^h 5	Ba(48-Mev α) chem; Ce^{136}(pile n,γ)
γ	**0.255**	$\alpha_K = 5.5 \pm 1.5$ sl ce,scin
		$K/L = 2.3 \pm 0.2$ M4 sl ce
x	**Ce K x ray**	crit a,pc

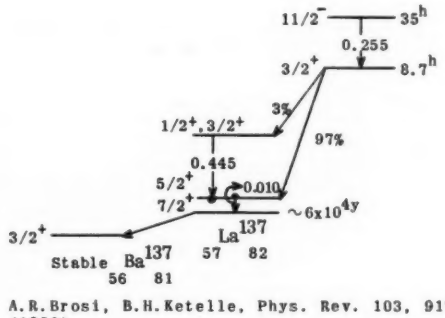
p $8.7^h Ce^{137}$

A.R.Brosi, B.H.Ketelle, Phys. Rev. 100, 169 (1955).

τ	34.1^h	La^{139}(p,3n)
$\gamma(Ce^{137})$	**0.2545**	

0.1% branching to a level ~0.800 in La^{137}

G.T.Danby, A.L.Thompson, J.S.Foster, Proc. Roy. Soc. Canada 50, 27A (1956).



A.R.Brosi, B.H.Ketelle, Phys. Rev. 103, 917 (1956).

$Ce^{139}_{58\ 81}$ 140^d g.s.

$\gamma(La^{139})$		$La^{(139)}$(22-Mev p,n), Ba(45-Mev α) chem
100%	**(0.166)** $\alpha_K = 0.22$ *1*	4π scin,sl
	K:L:M 26.6:3.7:1	
$\epsilon/\epsilon_K = 1.37$ 2	$\omega_K(La) = 0.88$ *1*	x/γ, xγ/x,
No ε to g.s. of La^{139}		xx/x,
$E_{dis} = 0.270$	$e_{AK}/ce_K = 0.62$ 4	e_{AK}/ce_K

B.H.Ketelle, H.Thomas, A.R.Brosi, Phys. Rev. 103, 190 (1956).

$\gamma(La^{139})$ **(0.166)** · E2/M1 ~0.04 $\gamma(\theta,T)$
$\gamma(\theta,T)$ consistent with $J = 3/2 \xrightarrow{\varepsilon} 5/2 \xrightarrow{\chi} 7/2$

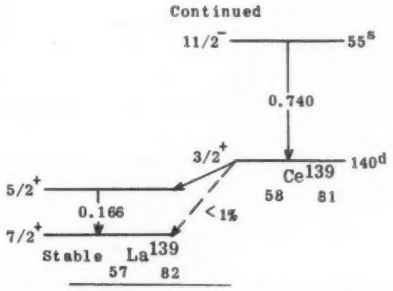
E.Ambler, R.P.Hudson, G.M.Temmer, Phys. Rev. 101, 196 (1956).

$Ce^{139}_{58\ 81}$ 55^s

τ	55^s *3*	Ce^{138}(pile n,γ)
$\gamma(Ce^{139})$	**0.740** 5 $\alpha_K = 0.08$ 2	scin
x	**Ce K x ray**	pc

Continued

$Ce^{139}_{58\ 81}$ Continued



B.H.Ketelle, H.Thomas, A.R.Brosi, Phys. Rev. 103, 190 (1956).

$Ce^{141}_{58\ 83}$ 33^d

$\gamma(Pr^{141})$	**0.1416** *3*	Ce^{140}(pile n,γ) sd ce

D.W.Martin, M.K.Brice, J.M.Cork, S.B.Burson, Phys. Rev. 101, 182 (1956).

$\gamma(Pr^{141})$		$Ce^{(140)}$(pile n,γ)
	(0.145) E2/M1 = 0.007 *3*	

$\gamma(\theta,T)$ and $\gamma(L,T)$ studied for aligned Ce

C.F.M.Cacho, M.A.Grace, C.E.Johnson, A.C. Knipper, R.G.Scurlock, R.T.Taylor, Phil. Mag. 46, 1287 (1955).

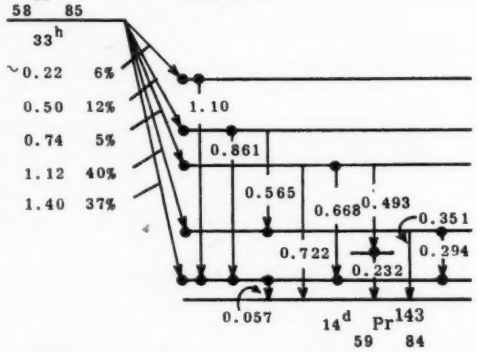
$Ce^{143}_{58\ 85}$ 33^h

τ		33.4^h		Ce^{142}(n,γ)
β^-	6%	~0.22		sd; scin β(1.10γ)
	12%	**0.50** *3*		sd; scin β(0.86γ)
	5%	**0.74** *15*		sd; scin β(0.67γ)
	40%	**1.125** *15*		sd; scin β(0.29γ)
	37%	**1.40** *2*		sd; scin β(0.06γ)
$\gamma(Pr^{143})$		**0.0574** 2	$\alpha_K = 5.9$ M1*	sπ ce,
		0.232 *1*		scin
		0.294 *1*	**0.668** 2	
		0.351 *1*	**0.722** 2	
		0.493 2	**0.861** *5*	
		0.565 *5***	**1.10** *1*$	

(0.057γ)(0.294, 0.668, 0.861, 1.10γ)
(0.232γ)(0.493γ) (0.294γ)(0.565γ)
No other γγ coincidences observed
No 1.46β (<2%) scinβ,βγ
No 0.126, 0.160γ
*L_2 ce not observed
**Observed only in (0.294γ) γ spectrum scin
$ce not observed

Continued

Ce^{143} 58 85 33^h — Continued



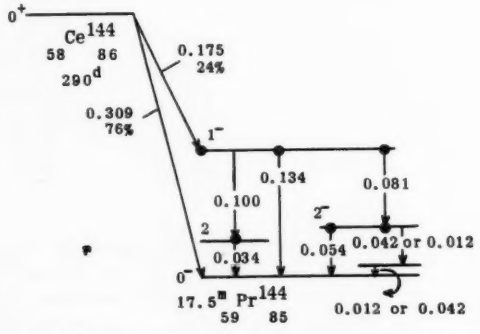
D.W.Martin, M.K.Brice, J.M.Cork, S.B.Burson, Phys. Rev. 101, 182 (1956).

Ce^{144} 58 86 290^d

U(n, f) chem

β^-	24%	**0.175** *5*				sl
	76%	**0.309** *5*				
$\gamma(Pr^{144})$		**0.012** ?				sl ce,pe; scin
	<7*	**0.0338** *3*				
	7*	**0.042**				
	~0.2*	**0.0539** *3*	α_K	K/L_1	L_1/M	
	17*	**0.0810** *3*	1.2 *3*	5.8 *7*	~10	
	<2*	**0.1003** *3*				
	29*	**0.1344** *3*	0.71 *25*	7.1 *5*	~4	

No β with $0.175 < E_\beta < 0.309$ (<5%)
<0.10 β group is possible
No γ with $0.050 < E_\gamma < 0.065$ (<3*)
No 0.054 photons (<1% of x rays) pc
No 0.145γ sl ce
$0.134\gamma/0.081\gamma = 2.60$ *5* $0.134\gamma/0.100\gamma = 7.5$ *5*
(0.175β)(x ray, 0.081, 0.134γ) scin
No ($E_\beta > 0.180$)(x ray, 0.081, 0.134γ)
(0.081γ)(x ray) (0.054γ)(x ray, 0.081γ)
(0.034γ)(0.100γ) (x ray)(x ray)
No (0.134γ)(γ, x ray)
*ce per 100 0.175β's



I.Pullman, P.Axel, Phys. Rev. 102, 1366 (1956).

Pr^{137} 59 78 1.5^h

τ	**1.5**^{h*}	$Ce^{(140)}(p,4n)$
β^+	**1.8**	
$\beta^+/\epsilon = 0.20$	No γ	

G.T.Danby, A.L.Thompson, J.S.Foster, Proc. Roy. Soc. Canada 50, 27A (1956); *Dahlstrom, ibid.

Pr^{141} 59 82

ground state

J	5/2	para
$\|\mu\|$	**3.9** *2*	

J.M.Baker, B.Bleaney, Proc. Phys. Soc. 68A, 936 (1955).

ground state

μ	**+4.0** *1*	S
q	**0.0** *2*	

K.Murakawa, J.Phys. Soc. Japan 9, 93 (1954).

$Pr^{141}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
No γ with $E_\gamma < 0.6$; 0.145 level not E2 excited

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

Pr^{143} 59 84 14^d

τ	**13.95**^{d}	$Ce^{142}(n,\gamma\beta)$
β^-	**0.93** *1*	sd

D.W.Martin, M.K.Brice, J.M.Cork, S.B.Burson, Phys. Rev. 101, 182 (1956).

Nd 60 Relative isotopic abundances ms

Nd^{142}	**27.3%** *2*		
Nd^{143}	**12.32%** *9*	Nd^{146}	**17.10%** *14*
Nd^{144}	**23.8%** *1.8*	Nd^{148}	**5.67%** *5*
Nd^{145}	**8.29%** *6*	Nd^{150}	**5.56%** *5*

No Nd^{139} ($<3\times10^{-4}$%)
No Nd^{147}, Nd^{152} ($<2\times10^{-4}$%)
No Nd^{140}, Nd^{149}, Nd^{151}, Nd^{153} ($<1\times10^{-4}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Nd(n, n'γ) $E_n = 4.4$

γ	**0.46** *1* in Nd^{146}	scin
	1.60 *2* in Nd^{142}	

Known level data suggest mass assignments

R.M.Sinclair, Westinghouse Research Report 60-94511-6-R12 (1956).

Nd^{143} 60 83 $Nd^{143}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
No γ with $E_\gamma < 0.6$

N. P. Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Nd^{144} 60 84 5×10^{15}y

τ	5×10^{15}y *2.5*	enriched Nd^{144} ppl
α	**1.8** *1*	ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956); 9a, 701 (1954).

$_{60}Nd^{145}_{85}$ γ $Nd^{145}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
0.070 *1* $\epsilon B(E2) \sim 0.03$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$_{60}Nd^{146}_{86}$ Level $Nd^{146}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
γ **0.455** *5* $\epsilon B(E2) = 0.84$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$_{60}Nd^{147}_{87}$ $_{12^d}$ ground state
J **9/2** $\gamma(\theta,T)$
$|\mu|$ **0.22** *5*

$\gamma(Pm^{147})$ **(0.092)** E2/M1 ~ 0.03 $\gamma(\theta,T)$
(0.530) E2 = 100%
$\gamma(\theta,T)$ shows $J = 9/2\text{-}\beta\rightarrow 9/2 - (0.530\,\gamma) \rightarrow 5/2$

E.Ambler, R.P.Hudson, G.M.Temmer, Phys. Rev. 101, 196 (1956); 97, 1212; 98, 230A (1955).

$_{60}Nd^{148}_{88}$ Level $Nd^{148}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
γ **0.300** *3* $\epsilon B(E2) = 1.50$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$_{60}Nd^{150}_{90}$ Natural Nd
$\tau_{\beta\beta}$ $> 2.2 \times 10^{18}$y scin $\beta\beta$

C.L.Cowan, F.B.Harrison, L.M.Langer, F. Reines, Nuovo Cim. 3, 649 (1956).

Level $Nd^{(150)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.132** *1* $\epsilon B(E2) \sim 0.3$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level $Nd^{150}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
γ **0.128** *1* $\epsilon B(E2) = 1.32$ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

$_{61}Pm^{147}_{86}$ $_{2.6^y}$ U(n,f) chem
$\gamma(Sm^{147})$ **0.121** scin

H.Langevin-Joliot, J. phys. radium 17, 497 (1956).

$_{62}Sm^{143}_{81}$ $_{9^m}$ $Sm^{(144)}(\leq 22\text{-Mev } \gamma, n)$
τ **9.0^3m**
β^+ **2.6** a
(γ,n) threshold = 9.6

E.Silva, J.Goldemberg, Nuovo Cim. 3, 12 (1956).

$_{62}Sm^{143}_{81}$ $_{9^m}$ τ **8.3^m** *3* $Sm^{(144)}(\leq 30\text{-Mev n,2n})$
β^+ **2.3** *3* a
No γ with $E_\gamma > 0.15$ scin

M.Mirnik, A.H.W.Aten,Jr., Physica 22, 14 (1956).

$_{62}Sm^{147}_{85}$ ground state
$|\mu|$ **0.83** *15* para
$|q|$ **< 0.72**
Calculated from data of G.S.Bogle, H.E.D. Scovil, Proc. Phys. Soc. 65A, 368 (1952).

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

$Sm^{147}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
No γ with $E_\gamma < 0.6$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$_{62}Sm^{148}_{86}$ Level $Sm^{148}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
γ **0.562** *6* $\epsilon B(E2) = 2.06$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level $Sm^{148}(p,p'\gamma)$ $E_p = 2.9$; scin
γ **0.55** *5* $\epsilon B(E2) = 0.74$

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Level $Sm^{148}(p,p'\gamma)$ $E_p = 3.29$; scin
γ **0.562** *8*

B.E.Simmons, K.F.Famularo, G.D.Freier, Phys. Rev. 100, 1265A (1955).

$_{62}Sm^{149}_{87}$ ground state
$|\mu|$ **0.68** *10* para
$|q|$ **< 0.72**
Calculated from data of G.S.Bogle, H.E.D. Scovil, Proc. Phys. Soc. 65A, 368 (1952)

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

$Sm^{149}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
No γ with $E_\gamma < 0.6$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$_{62}Sm^{150}_{88}$ Level $Sm^{150}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
γ **0.337** *3* $\epsilon B(E2) = 2.32$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level $Sm^{150}(p,p'\gamma)$ $E_p = 2.9$; scin
γ **0.335** *17* $\epsilon B(E2) = 0.51$

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Sm^{150} 62 88

Level	$Sm^{150}(p,p'\gamma)$	$E_p = 2.61$; scin
γ	**0.337** *3*	$p,\gamma(\theta)$ studied

B.E. Simmons, K.F. Famularo, G.D. Freier, Phys. Rev. 100, 1265A (1955).

Capture γ's	$Sm^{(149)}$(th n,γ)			sπ Cp
38†	**0.33** *1*		~**4.15** *10*	
33†	**0.44** *1*		~**4.25** *10*	
12†	**0.60** *1*		~**4.40** *10*	
7†	**0.67** *2*		~**4.50** *10*	
19†	**0.76** *1*	> 0.15†	**4.65** *10*	
	0.90 *3*		**4.8** *1*	
	0.95 *3*		**5.0** *1*	
3†	**1.07** *2*	> 0.5†	**5.60** *5*	
7†	**1.20** *2*		~**5.9** *1*	
> 2†	**1.27** *3*	> 0.3†	**6.00** *5*	
> 5†	**1.35** *2*	~ 0.35†	**6.54** *10*	
	~**1.50** *5*	~ 0.06†	**6.80** *5*	
	~**1.60** *5*	0.7†	**7.22** *3*	

Level scheme implies $B_n = 8.00$ *3*
Levels proposed at 0.33, 0.77, 1.20, 1.43, 1.54, 2.00, 2.30, 3.35
Lines between 1.60 and 4.15 not resolved
†Photons/100 Sm captures

B.P. Adyasevich, B.D. Groshev, A.M. Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 270 July (1955); Consultants Bureau Trans. p. 195.

Sm^{152} 62 90

Level	$Sm^{152}(p,p'\gamma)$	$E_p = 2.28$; scin
γ	**0.124** *2*	$p,\gamma(\theta)$ studied

B.E. Simmons, K.F. Famularo, G.D. Freier, Phys. Rev. 100, 1265A (1955).

Level	$Sm^{152}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$; scin
γ	**0.122** *1*	$\epsilon B(E2) = 1.36$

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level	$Sm^{152}(p,p'\gamma)$	$E_p = 2.9$; scin
γ	**0.125** *6*	$\epsilon B(E2) = 0.43$

H. Mark, G.T. Paulissen, Phys. Rev. 100, 813 (1955).

Level	$Sm^{(152)}(p,p'\gamma)$	$E_p = 1.75$
γ	**0.123** *1*	$\epsilon B(E2) = 0.56$ sd ce_L

T. Huus, J.H. Bjerregaard, B. Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level	$Sm^{152}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$
γ	**0.122** *1*	$\epsilon B(E2) = 1.52$ scin

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Sm^{153} 62 91 47^h

β^-	0.06%	**0.130**	32%	**0.720**	scin
	41%	**0.645**	27%	**0.825**	
$\gamma(Eu^{153})$					
	680*	**0.070**			scin
	1000*	**0.100**	0.65*	**0.530**	
	0.45*	**0.170**	0.15*	**0.600**	
(0.53 γ)(0.07, 0.10 γ)			(0.10 γ)(0.07, 0.60 γ)		
No (0.60 γ)(0.07 γ)					

*Estimated relative transition probabilities

V.S. Dubey, C.E. Mandeville, N.A. Rothman, Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956); verbal report.

$\gamma(Eu^{153})$	1†	**0.07**	scin
	10†	**0.10327** *2*	cryst

B. Andersson, Proc. Phys. Soc. 69A, 415 (1956).

Sm^{154} 62 92

Level	$Sm^{154}(p,p'\gamma)$	$E_p = 2.07$; scin
γ	**0.085** *3*	$p,\gamma(\theta)$ studied

B.E. Simmons, K.F. Famularo, G.D. Freier, Phys. Rev. 100, 1265A (1955).

Level	$Sm^{154}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$; scin
γ	**0.082** *1*	$\epsilon B(E2) = 0.48$

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level	$Sm^{154}(p,p'\gamma)$	$E_p = 2.9$; scin
γ	**0.084** *4*	$\epsilon B(E2) = 0.27$

H. Mark, G.T. Paulissen, Phys. Rev. 100, 813 (1955).

Level	$Sm^{(154)}(p,p'\gamma)$	$E_p = 1.75$
γ	**0.083** *1*	$\epsilon B(E2) = 2.9$ sd ce_L

T. Huus, J.H. Bjerregaard, B. Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level	$Sm^{154}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$
γ	**0.082** *1*	$\epsilon B(E2) = 0.80$ scin

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Eu^{151} 63 88

Levels	$Eu^{151}(\alpha,\alpha'\gamma)$	$E_\alpha = 6.5$ scin
	0.195 level	
γ	**0.195**	$\epsilon B(E2) = 0.067$
	0.304 level	
γ	**0.110**	$\epsilon B(E2) = 0.024$
	0.195	
	0.304	$\epsilon B(E2) = 0.22$

N.P. Heydenburg, G.M. Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

$_{63}Eu^{151}_{88}$ γ $Eu^{(151)}(p,p'\gamma)$ $E_p = 2.9$; scin

0.300 *15*

H. Mark, G. T. Paulissen, Phys. Rev. 100, 813 (1955).

$_{63}Eu^{152}_{89}$ τ **12.7^y** *2* Eu(pile n)

13^y g.s.

E. E. Lockett, R. H. Thomas, Nucleonics 14, No. 11, 127 (1956); 11, No. 3, 14 (1953).

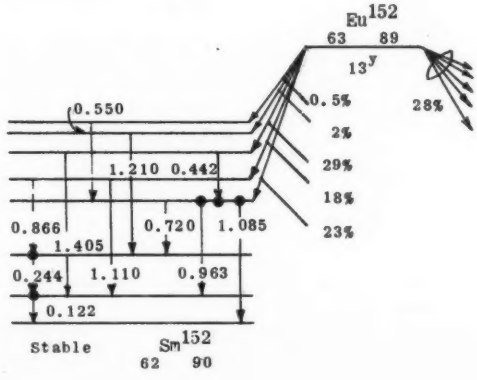
β^-	2%	**1.000**			sl
	13%	**1.460**			
$\gamma(Sm^{152})$					
	59%	**0.122**			sl ce, scin
	9%	**0.244**	14%	**0.963**	
	5%	**0.442**	13%	**1.085**	
	0.5%	**0.550**	12%	**1.110**	
	1%	**0.720**	2%	**1.210**	
	6%	**0.866**	25%	**1.405**	
$\gamma(Gd^{152})$					
	27%	**0.344**	9%	**0.778**	
	2.5%	**0.408**	1.5%	**1.100**	
	0.3%	**0.690**	2%	1.240	

(0.122 γ)(0.963, 1.110, 1.405 γ)
(0.244 γ)(0.866, 1.210 γ)
(0.442 γ)(0.963, 1.085 γ)
(0.344 γ)(0.778, 1.100, 1.240 γ)
(0.408 γ)(0.344, 0.690 γ)
(1.00 β)(0.408 γ) (1.46 β)(0.344 γ) scin

L. Grodzins, H. Kendall, Bull. Am. Phys. Soc. 1, No. 4, 163 B10, 164 B11 (1956); verbal report.

$\gamma(Sm^{152})$	**0.12231** *4*	cryst
	0.24464 *8*	
$\gamma(Gd^{152})$	**0.34434** *23*	

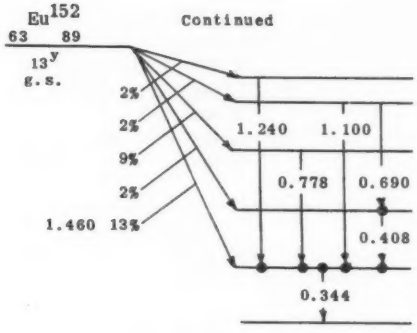
B. Andersson, Proc. Phys. Soc. 69A, 415 (1956).



Continued

$_{63}Eu^{152}_{89}$ 13^y g.s.

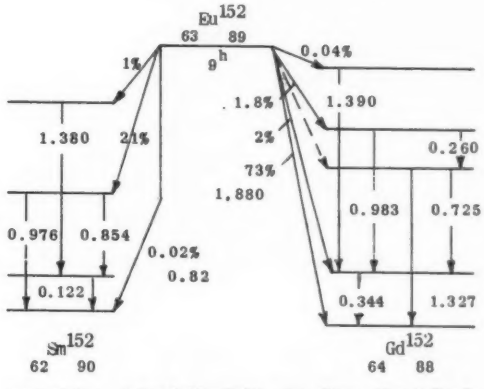
Continued



L. Grodzins, H. Kendall, Bull. Am. Phys. Soc. 1, No. 4, 163 B10, 164 B11 (1956); verbal report.

$_{63}Eu^{152}_{89}$ 9.2^h

β^+		**0.82** *10*			scin
β^-		**1.880**			sl
$\gamma(Sm^{152})$					sl ce, scin
	15.2%	**0.122**	6.7%	**0.976**	
	14.2%	**0.854**	1.0%	**1.380**	
$\gamma(Gd^{152})$					
	0.1%	**0.260**	0.5%	**0.983**	
	2.7%	**0.344**	1.2%	**1.327**	
	0.1%	**0.725**	0.04%	**1.390**	



L. Grodzins, H. Kendall, Bull. Am. Phys. Soc. 1, No. 4 163 B10, 164 B11 (1956); verbal report.

$_{63}Eu^{153}_{90}$ Levels $Eu^{(153)}(p,p'\gamma)$ $E_p = 2.9$; scin

0.085 level

γ **0.085** *4* $\epsilon B(E2) = 0.20$

0.200 level

γ **0.085** *4*
0.115 *6*
0.200 *10* $\epsilon B(E2) = 0.14$

H. Mark, G. T. Paulissen, Phys. Rev. 100, 813 (1955).

Levels $Eu^{(153)}(p,p'\gamma)$ $E_p = 1.75$

0.084 level

γ **0.084** *1* $\epsilon B(E2) = 0.65$ sd ce_L

0.195 level

γ **0.084** *1*
$\sim$**0.111** *1* $\epsilon B(E2) < 0.05$ ce_L
0.195 *2* $\epsilon B(E2) \sim 0.05$ ce_K

T. Huus, J. H. Bjerregaard, B. Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$^{153}_{63}Eu_{90}$

Levels $Eu^{153}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$ scin

0.082 level

γ **0.082** $\epsilon B(E2) = 0.60$

0.187 level

γ **0.082**

0.105 $\epsilon B(E2) = 0.18$

0.187 $= 0.29$

N.P.Heydenburg, G.M.Temmer, Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956); verbal report.

Levels $Eu^{(153)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

0.082 level

γ **0.082** *1* $\epsilon B(E2) = 0.36$

0.187 level

γ **0.082** *1*

0.3† **0.105** *1*

1† **0.187** *2* $\epsilon B(E2) = 0.49$

$(0.082\gamma)(0.105\gamma)$

Assignment to Eu^{151} also possible

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956); verbal report..

$^{154}_{63}Eu_{91}$ $^{16^y}$

$\gamma(Gd^{154})$ **0.12354** *9* cryst

B.Andersson, Proc. Phys. Soc. 69A, 415 (1956).

$\gamma(Gd^{154})$ $Eu^{(153)}$(pile n,γ); scin

$(1.42\gamma)(0.123\gamma)(\theta)$ consistent with J = 6, 2, 0

B.Hartmann, T.Wiedling, Arkiv Fysik 10, 355 (1956).

$^{155}_{63}Eu_{92}$ $^{1.7^y}$

β^- 79% **0.150** *10* scin

21% **0.240** *10*

$\gamma(Gd^{155})$ **0.018** scin

0.084

0.102

No $(0.24\beta)\gamma$

V.S.Dubey, C.E.Mandeville, M.A.Rothman, Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956); verbal report.

$^{Gd}_{64}$

No α's $\tau > 4x10^{16y}$ for $1.5 < E_\alpha < 2.5$; ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

$^{153}_{64}Gd_{89}$ $^{236^d}$

$\gamma(Eu^{153})$ $Gd^{(152)}$(pile n,γ)

5† **0.069** K/L > 4.5 scin,s ce

~28† **0.098** *5* $\alpha_K = 0.3^*$ *1* E1

~27† **0.103** K/L = 6

x 100† **K x ray**

Continued

$^{153}_{64}Gd_{89}$ $^{236^d}$ Continued

$(ce_K\ 0.098\gamma)/(ce_K\ 0.103\gamma) = 0.25$ *5*

No $(0.098\gamma)(0.103\gamma)$ No β^+

Authors conclude $\epsilon_L/\epsilon_K > 1$, $E_{dis} \sim 0.22$

*Assuming $\alpha_K = 1.2$ for 0.103γ

N.Marty, M.Vergnes, Compt. rend. 242, 1438 (1956).

$\gamma(Eu^{153})$ source not described

7† **0.072** *8* scin

100† **0.100** *4* $\alpha_K = 0.67$ *12* xy/γ, xx/x,

x 160† **K x ray** x/γ

(K x ray)(K x ray, 0.072?, 0.100γ)

No other γ

Authors conclude $\epsilon_L/\epsilon_K \sim 0.42$, $E_{dis} \sim 0.20$

$E_{dis} = 0.225^*$ Σ scin

S.K.Bhattacherjee, S.Raman, Nuclear Phys. 1, 486 (1956); *R.K.Gupta, S.Jha, ibid.

$Gd^{(152)}$(pile n,γ)

$\gamma(Eu^{153})$ **0.104** $\alpha_K = 0.68^*$ *2* scin xx/xy

x **K x ray** scin

L x ray pc

$\epsilon_L/\epsilon_K = 0.68^*$ *2* Σ scin, scin xy/γ

ω_L(Eu) = 0.17 pc, scin xy/γ

K x ray/0.104γ = 1.65 *2* scin

Authors conclude $E_{dis} = 0.083$ *2* + 0.104 (E_γ)

No ϵ to g.s. of Eu^{153} (< 3%)*

*Used $\omega_K = 0.91$ and K/L = 5.3 for 0.104γ

A.Bisi, E.Germagnoli, L.Zappa, Nuclear Phys. 1, 593 (1956).

$\gamma(Eu^{153})$ **(0.103)** $\alpha = 1.2$ Σ scin

No ϵ to g.s. (<10%) Σ scin

S.G.Cohen, Y.Burde, S.Ofer, Bull. Research Council Israel 5A, 87A (1955).

$^{154}_{64}Gd_{90}$

Level $Gd^{154}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

γ **0.123** *1* $\epsilon B(E2) = 2.10$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); verbal report.

Level $Gd^{154}(p,p'\gamma)$ $E_p = 1.9$; scin

γ **0.123*** *6* $\epsilon B(E2) = 1.0$

*Composite γ

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

$^{155}_{64}Gd_{91}$

	ground state
J	3/2*
μ	-0.30 *4*
q	+1.1 *3*

enriched Gd^{155}; S

Continued

Gd^{155} 64 91

Continued

$\mu(Gd^{155})/\mu(Gd^{157}) = 0.80\ 2$

*Value consistent with theory for deformed nuclei[$], not with shell model prediction

D.R.Speck, Phys. Rev. 101, 1725 (1956); 100, 973A (1955); $B.R.Mottleson, S.G.Nilsson, Phys. Rev. 99, 1615 (1955).

Levels	$Gd^{155}(\alpha,\alpha'\gamma)$	$E_\alpha = 1.75$
	$Gd^{155}(p,p'\gamma)$	$E_p = 1.75$
γ	**0.060** *1* $\epsilon B(E2) = 0.48$	sd ce_L
	0.146 2 $\epsilon B(E2) = 0.06$	sd ce_K

J.H.Bjerregaard, U.Meyer-Berkhout, Z. Naturf. 11a, 273 (1956).

Level	$Gd^{155}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$
γ	**0.145** *1* $\epsilon B(E2) = 0.105$	scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Level	$Gd^{155}(p,p'\gamma)$	$E_p = 2.9$
γ	**0.140** *14*	scin

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Gd^{156} 64 92

Level	$Gd^{156}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$; scin
γ	**0.089** *1* $\epsilon B(E2) = 1.24$	

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level	$Gd^{156}(p,p'\gamma)$	$E_p = 1.9$; scin
γ	**0.089** *5* $\epsilon B(E2) = 0.74$	

H. Mark, G.T. Paulissen, Phys. Rev. 100, 813 (1955).

Resonance	$Gd^{(155)}(n)$	
	2.01 ev Γ_γ = **104** *5* mev	

E.T.Florance, V.L.Sailor, quoted by H.H. Landon, Phys. Rev. 100, 1414 (1955).

Gd^{157} 64 93

	ground state	enriched Gd^{155}; S
J	**3/2***	
μ	**−0.37** *4*	
q	**+1.0** *3*	

*Value consistent with theory for deformed nuclei[$], not with shell model prediction

D.R.Speck, Phys. Rev. 101, 1725 (1956); 100, 973A (1955); $B.R.Mottleson, S.G.Nilsson Phys. Rev. 99, 1615 (1955).

Gd^{157} 64 93

Levels	$Gd^{157}(\alpha,\alpha'\gamma)$	$E_\alpha = 1.75$
	$Gd^{157}(p,p'\gamma)$	$E_p = 1.75$
γ	**0.055** *1* $\epsilon B(E2) = 0.54$	sd ce_L
	0.132 2 $\epsilon B(E2) = 0.03$	

J.H.Bjerregaard, U.Meyer-Berkhout, Z. Naturf. 11a, 273 (1956).

Level	$Gd^{157}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$
γ	**0.131** *1* $\epsilon B(E2) = 0.086$	scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Level	$Gd^{157}(p,p'\gamma)$	$E_p = 2.9$
γ	**0.127** *13*	scin

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Gd^{158} 64 94

Level	$Gd^{158}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$; scin
γ	**0.079** *1* $\epsilon B(E2) = 1.02$	

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); verbal report.

Level	$Gd^{158}(p,p'\gamma)$	$E_p = 1.9$; scin
γ	**0.080** *4* $\epsilon B(E2) = 0.63$	

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Resonance	$Gd^{(157)}(n)$	
	2.82 ev Γ_γ = **114** *5* mev	

E.T.Florance, V.L.Sailor, quoted by H.H. Landon, Phys. Rev. 100, 1414 (1955).

Gd^{159} 64 95 18^h

$\gamma(Tb^{159})$	**(0.058)**		
	0.080		scin
2.5†	**0.225** *10*		sl ce, scin
0.5†	~**0.300**		scin
100†	**0.362** 2	K/L~2	sl ce, scin

$(\sim 0.95\beta)(0.058\gamma)$ $(0.225\gamma)(0.058,\ 0.080\gamma)$

$\alpha_K(0.225\gamma)/\alpha_K(0.362\gamma) = 15\ 10$

R.Ballini, R.Barloutaud, J. phys. radium 17, 534 (1956).

Gd^{160} 64 96

Level	$Gd^{160}(\alpha,\alpha'\gamma)$	$E_\alpha = 6$; scin
γ	**0.076** *1* $\epsilon B(E2) \sim 1$	

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

Level	$Gd^{160}(p,p'\gamma)$	$E_p = 1.9$; scin
γ	**0.076** *4* $\epsilon B(E2) = 0.73$	

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

$Tb^{158}_{65\ 93}$? τ **11^s** $Tb^{159}(\gamma)$
$^{s}_{11}$ x **Tb K x ray** scin

M.G.Stewart, A.J.Bureau, C.L.Hammer, Bull. Am. Phys. Soc. 1, No. 4, 206 R2 (1956); verbal report.

$Tb^{159}_{65\ 98}$ Level $Tb^{159}(\alpha,\alpha'\gamma)$ E_α = 6; scin

	0.136 level	
γ	**0.079** *1*	ϵB(E2) = 0.19
	0.136 *1*	= 0.041

Yields show that both γ's are from 0.136 level

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

γ $Tb^{159}(p,p'\gamma)$ E_p = 2.9; scin
0.077 *4*

Also observed 0.17 γ; Er or Dy impurity?

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Level $Tb^{159}(\alpha,\alpha'\gamma)$ E_α = 6

	0.136 level	
γ	100† **0.079**	scin
	30† **0.136**	

G.M.Temmer, N.P.Heydenburg, Bull. Am. Phys. Soc. 1, No. 1, 43, K11 (1956); verbal report.

$Tb^{160}_{65\ 95}$ β^- 14% **0.367** *12* 35% **0.861** *2* sl
$^{73^d}$ 51% **0.564** *7* 0.3% **1.711** *7*
γ's and $\beta\gamma$'s are reported scin,sl pe,sl ce

G.Bertolini, M.Bettoni, E.Lazzarini, Nuovo Cim. 3, 754 (1956).

$(0.30\gamma)(E_\gamma > 0.75)(\theta)$
Consistent with J = 4, 2, 0 and J = 4, 2, 2

G.Bertolini, M.Bettoni, E.Lazzarini, Nuovo Cim. 3, 1162L (1956).

$Tb^{161}_{65\ 96}$ τ **7.15^d** Gd^{160}(pile n,$\gamma\beta$)
$^{7.15^d}$ β^- **0.540** complex?
$\gamma(Dy^{161})$ **0.0256** **0.0748** s ce
0.0277 **0.0783**
0.0489 **0.1062**
0.0573 **0.1321**

Scin $\gamma\gamma$ supports Dy^{161} levels at 0.0256, 0.0748, 0.1040, and 0.1320

J.M.Cork, M.K.Brice, L.C.Schmid, R.G.Helmer, Bull. Am. Phys. Soc. 1, No. 6, 297 R7 (1956).

$Tb^{161}_{65\ 96}$ τ **6.9^d** *1* $Gd^{(160)}$(pile n,$\gamma\beta$)
$^{7.15^d}$ β^- ~1000† **0.500** *3* F-K linear $E_\beta > 0.10$ sl
$\gamma(Dy^{161})$

100†	**0.0259** *2*		scin,pc
31†*	**0.049** *2*	$\alpha \sim 1.5$	$\gamma\gamma/\gamma$
57†	**0.077** *2*	$\alpha_K < 3.5$[$]	
x 150†*	**K x ray**		

$(E_\beta > 0.20)(0.0259, 0.049, 0.077\gamma)$ scin
$(0.049\gamma\gamma)(0.0259\gamma)$ No $\gamma(0.077\gamma)$
No $\beta(0.106\gamma)$. γ observed but assigned to Gd^{153}
*Assuming α_K = 2.9 for 0.077 γ
[$]From (0.049$\gamma$+K x ray)/(0.077$\gamma$) = 3.2

A.Bisi, S.Terrani, L.Zappa, Nuclear Phys. 1, 425 (1956).

$\gamma(Dy^{161})$ ~0.046 sl ce
w ~0.673
ce **0.092** (~ a few % of β's)

R.Ballini, R.Barloutaud, J. phys. radium 17, 498 (1956).

Dy 66 Levels $Dy(\alpha,\alpha'\gamma)$ E_α = 6; scin

γ	**0.076** *1*	ϵB(E2) = 0.23*
	0.166 *2*	= 0.29[$]

*Assuming γ due to A = 161, 162, 163 and 164
[$]Assuming γ due to A = 161 and 163

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

Resonances $Dy(n,\gamma)$ pulsed n's
1.72 ev scin γ
5.9
Different γ's emitted at these resonances

A.E.Walters, C.A.Fenstermacher, L.Rosler, R.G.Bennett, C.K.Bockelman, H.L.Schultz, W.G.Wadey, Bull. Am. Phys. Soc. 1, No. 6, 296 R4 (1956).

$Dy^{161}_{66\ 95}$

ground state	
J	**5/2** para
$\lvert\mu\rvert$	**0.38*** *5*
$\lvert\mu(Dy^{163})/\mu(Dy^{161})\rvert$	= 1.41 *2*

*If g.s. of Dy^{+++} ion in crystal is $^6H_{15/2}$

A.H.Cooke, J.G.Park, Proc. Phys. Soc. 69A, 282 (1956).

ground state	
J	**3/2** S
$\mu(Dy^{163})/\mu(Dy^{161})$	= 1.07 *5*
$q(Dy^{163})/q(Dy^{161})$	~1

K.Murakawa, J. Phys. Soc. Japan 11, 804 (1956).

$Dy^{162}_{66\ 96}$ Level $Dy^{(162)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.082** *1* $\epsilon B(E2) = 3.2$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab, Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$Dy^{163}_{66\ 97}$

ground state
J **5/2** para
$|\mu|$ **0.53*** *5*
$|\mu(Dy^{163})/\mu(Dy^{161})| = 1.41$ *2*
*If g.s. of Dy^{+++} ion in crystal is $^6H_{15/2}$

A.H.Cooke, J.G.Park, Proc. Phys. Soc. 69A, 282 (1956).

ground state
J **3/2*** S
$\mu(Dy^{163})/\mu(Dy^{161}) = 1.07$ *5*
$q(Dy^{163})/q(Dy^{161}) \sim 1$
*From $J(Dy^{163}) = J(Dy^{161})$[$] and $J(Dy^{161}) = 3/2$

K.Murakawa, J. Phys. Soc. Japan 11, 804 (1956) 1; [$]Phys. Rev. 92, 325 (1953).

$Dy^{164}_{66\ 98}$ Level $Dy^{(164)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.075** *1* $\epsilon B(E2) = 4.8$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$Dy^{165}_{66\ 99}$ 2.3^h g.s. $\gamma(Ho^{165})$ **0.094793** *7* cryst

B.Andersson, Proc. Phys. Soc. 69A, 415 (1956).

$\gamma(Ho^{165})$ **(0.095)** M1 scin
$\alpha_K = 2.9$ *3* K x ray/γ

T.Stribel, Z. Naturf. 10a, 894 (1955).

$Ho^{163?}_{67\ 96}$ $\sim 1^S$ τ $\sim 1^S$ $Ho^{165}(\geq 16.3\text{-Mev } \gamma)$
γ **0.305** scin

M.G.Stewart, A.J.Bureau, C.L.Hammer, Bull. Am. Phys. Soc. 1, No. 4, 206 R2 (1956); verbal report.

$Ho^{165}_{67\ 98}$

ground state
J **7/2** para
$|\mu|$ **3.29** *17*
$|q|$ ~ 2 μ and q have same sign

J.M.Baker, B.Bleaney, Proc. Phys. Soc. 68A, 1090 (1955).

$Ho^{165}_{67\ 98}$ Levels $Ho^{165}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin
γ **0.094** *1* $\epsilon B(E2) = 0.54$
0.206 *2* $= 0.036$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

Level $Ho^{165}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
0.206 level
γ 100† **0.112** scin
21† **0.206**

G.M.Temmer, N.P.Heydenburg, Bull. Am. Phys. Soc. 1, No. 1, 43, K11 (1956); verbal report.

Er
68 Levels $Er(p,p'\gamma)$ $E_p = 1.75$
γ **0.081** *1* $\epsilon B(E2) = 3.6$* sd ce_L
*If γ is ascribed to all even Er isotopes

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Levels $Er(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
γ **0.079** *1* $\epsilon B(E2) = 0.83$* scin
0.172 *1* $= 0.064$[$]
*If γ is ascribed to all Er isotopes
[$]If γ is ascribed to A = 167

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955); priv. comm.

$Er^{165}_{68\ 97}$ 9.9^h Er(pile n) chem
Assignment of 9.9^hEr to mass 165 confirmed, ms

D.R.Nethaway, M.C.Michel, W.E.Nervik, Phys. Rev. 103, 147 (1956).

$Er^{167}_{68\ 99}$

ground state
$|\mu|$ **0.50** *12* para
$|q|$ **10** *2*
Recalculated from data of G.S.Bogle et al., Proc. Phys. Soc. 65A, 760 (1952)

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

$Er^{167}_{68\ 99}$ 2.5^S ? τ 2.5^S Er(γ)
γ **0.210** scin

M.G.Stewart, A.J.Bureau, C.L.Hammer, Bull. Am. Phys. Soc. 1, No. 4, 206 R2 (1956); verbal report.

τ 2.5^S Er(pile n)
γ **0.210** *10* $\alpha_K = 0.55$ *10* E3 scin

E.C.Campbell, J.H.Kahn, M.Goodrich, ORNL-1164 (1951).

$Er^{171}_{68\ 103}$ 7.5^h Er(pile n) chem
Assignment of 7.5^hEr to mass 171 confirmed, ms

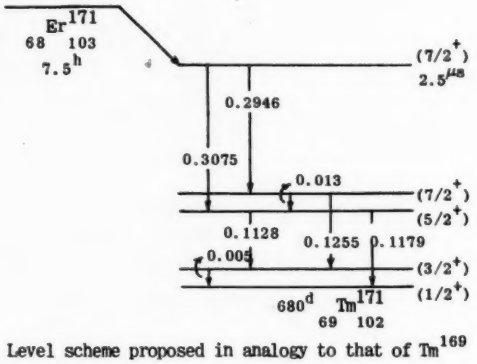
D.R.Nethaway, M.C.Michel, W.E.Nervik, Phys. Rev. 103, 147 (1956).

$Er^{171}_{68\ 103}$ 7.5^h

$\gamma(Tm^{171})$ $Er^{(170)}$(slow n,γ); scin

0.115	(0.1128, 0.1179, 0.1255)*	
0.300	(0.2946, 0.3975)*	

β(0.115, 0.300γ) delay
(0.115γ)(0.300γ) No (0.115γ)(0.115γ)
No 0.176, 0.420γ (< 1% of 0.300γ)



Level scheme proposed in analogy to that of Tm^{169}

S.D.Koički, A.M.Koički, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 1 (1956); *H.B.Keller, J.K.Cork, Phys. Rev. 84, 1079 (1951).

$Er^{172}_{68\ 104}$ 50^h

τ **49.8^h** *10* Er(pile n) chem

From milking $64^h Tm^{172}$(q.v.) from Er

D.R.Nethaway, M.C.Michel, W.E.Nervik, Phys. Rev. 103, 147 (1956).

$Tm^{169}_{69\ 100}$ Stable

	ground state	
J	**1/2**	S
μ	**-0.205** *20*	

μ agrees very well with the predictions of the collective model of the nucleus*

K.H.Lindenberger, Z. Phys. 141, 476 (1955); Naturwiss. 42, 41 (1955). *B.R.Mottelson, S.G.Nilsson, Z. Phys. 141, 217 (1955).

$Tm^{169}_{69\ 100}$ Level $Tm^{169}(p,p'\gamma)$ $E_p = 1.75$

0.119 level

γ	**0.111** *1*	$\epsilon B(E2) \sim 2$	sd ce_K
		$= 0.32$	ce_L
	0.119	$= 0.11$	ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level $Tm^{169}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.120 level

γ	**0.109** *1*	$\epsilon B(E2) = 1.40$	scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955); priv. comm.

$Tm^{170}_{69\ 101}$ 127^d

β^-	24%*	**0.867** *5*	scin $\beta\gamma, \beta_x$
	76%	**0.950** *5*	scin
$\gamma(Yb^{170})$			
	0.084	$\alpha_K = 1.69$ *2*	scin x/γ

*From $\beta\gamma/\beta$ if $\alpha = 8.7$ for 0.084γ

A.Bisi, E.Germagnoli, L.Zappa, Nuovo Cim. 3, 1007 (1956).

$\gamma(Yb^{170})$ **(0.084)** Tm^{169}(pile n,γ) chem
K:L:M:N = 100:314:72:9.6 sd ce

P.R.Gray, Phys. Rev. 101, 1306 (1956).

$\gamma(Yb^{170})$ **0.08426** *2* cryst

E.N.Hatch, F.Boehm, J.W.M.DuMond, priv. comm. (1955).

$\gamma(Yb^{170})$ Tm^{169}(pile n,γ)

	107†	**0.084229** *41*	cryst
x	191†	**Yb K x ray**	
	6.4†	**Er K x ray***	

No other γ with $0.070 < E_\gamma < 0.083$, or $0.085 < E_\gamma < 0.090$ (< 2†)
*Not due to $87^d Tm^{168}$ (no 0.85γ) scin

P.P.Day, Phys. Rev. 102, 1572 (1956).

$Tm^{171}_{69\ 102}$ 680^d Er(pile n) chem
Assignment of 680^dTm to mass 171 confirmed, ms

D.R.Nethaway, M.C.Michel, W.E.Nervik, Phys. Rev. 103, 147 (1956).

$Tm^{172}_{69\ 103}$ 64^h

τ		**63.6^h** *3*	Er(pile n) chem, ms	
β^-		**1.5**		a
$\gamma(Yb^{172})$		**0.076**	**1.09**	scin
	w	**0.18**	**1.44**	
	w	**0.40**	**1.79**	
x		**K x ray**		

D.R.Nethaway, M.C.Michel, W.E.Nervik, Phys. Rev. 103, 147 (1956).

Yb 70

Levels $Yb(p,p'\gamma)$ $E_p = 1.75$

γ	**0.077** *1*	$\epsilon B(E2) = 3.9$*	sd ce_L

*If γ is ascribed to all even Yb isotopes

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Levels $Yb(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

	Level	$\epsilon B(E2)$	Isotope
γ	**0.078** *1*	0.49	all but 171
	0.110 *1*	0.25	171
	0.180 *2*	0.065	173

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955); priv. comm.

$_{70}Yb^{169}_{99}$ $_{31}^{d}$

τ	30.6^{d} 2	$Yb^{(168)}$(pile n,γ)
$\gamma(Tm^{169})$	**0.0084**	sπ ce
	0.0206	K : L_1 : L_2 : L_3
	0.0632	100 : 43 : 55
	0.0936	210 : 100 : 18 : 10
	0.1099	360 : 100 : 19 : 6
	0.1183	9 : 10 E2
	0.1307	150 : 100 : 90
	0.1777	56 : 10
	0.1986	66 : 10
	0.2610	
	0.3083	35 : 10

(0.178 γ)(0.131 γ) (0.261 γ)(~0.115 γ)
No (0.261 γ)(0.131, ~0.19, 0.308 γ)
Sum peaks at 0.115, 0.263, 0.317 Σ scin
No 0.143, 0.160 γ sπ ce

J.M.Cork, M.K.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100, 1237A (1955).

$\gamma(Tm^{169})$				sl ce,cryst
	0.00842			
	0.02075			$\frac{\alpha_K}{0.51}$
	0.06312	$\frac{\alpha_K}{2.4}$	**0.17724**	
	0.09360	2.1	**0.19797**	0.40
	0.10978		**0.2404**	
	0.11820		**0.2610**	
	0.13053		**0.3077**	

All γ's fitted into levels at 0.00842, 0.11820, 0.13895, 0.31619, 0.37931, 0.47291

E.N.Hatch, P.Marmier, F.Boehm, J.W.M.DuMond, Bull. Am. Phys. Soc. 1, No. 4, 170 E1 (1956); verbal report.

$\gamma(Tm^{169})$			$Yb^{(168)}$(pile n,γ)	
	0.063	178†	**0.178**	scin
	0.094	226†	**0.198**	
157†	**0.110**	20†	**0.260**	
96†	**0.132**	95†	**0.308**	

(0.110 γ)(0.178?*, 0.198 γ)
(0.132 γ)(0.178 γ)
Only 0.063 and 0.094γ precede 0.7$^{\mu s}$ level $\gamma\gamma$ delay
No ϵ to 0.120 or 0.142 level $x\gamma$ delay
(K x ray)(0.063, 0.094, 0.260 γ) delay $<0.3^{\mu s}$
*(0.110 γ)(0.178 γ) <0.1 of (0.132 γ)(0.178 γ)

S.D.Koički, A.M.Koički, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 1 (1956).

$\gamma(Tm^{169})$			$Yb^{(168)}$(pile n,γ)	
20%§	**(0.023)**	146+	**0.178**	scin
250+	**0.064**		~**0.194***	
34+	**0.094**	214+	**0.198**	
144+	**0.110**		~**0.240***	
	~**0.120***		~**0.260***	
91+	**0.133**	60+	**0.308**	
x 1130+	K x ray			

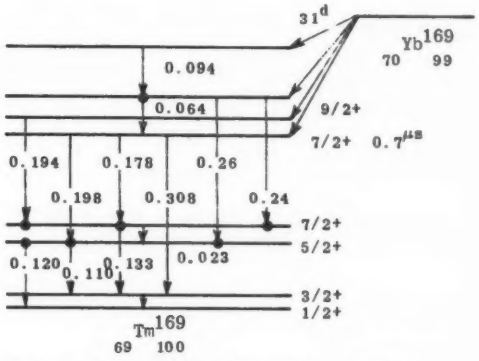
(0.110 γ)(0.178, 0.198, ~0.260 γ)
(0.133 γ)(0.178, ~0.194, ~0.240 γ)
(0.198 γ)(0.110, ~0.120 γ)

Continued

$_{70}Yb^{169}_{99}$ $_{31}^{d}$

Continued

Only 0.064 γ and 0.094 γ precede 0.7$^{\mu s}$ level $\gamma\gamma$ delay
No ϵ to 0.120 or 0.142 level $x\gamma$ delay
*Observed only in coincidence spectra
§From intensities of (0.110 γ)γ and (0.178 γ) γ
+Photons per 10^3 disintegrations



S.A.E.Johansson, Phys. Rev. 100, 835 (1955).

$_{70}Yb^{169}_{99}$

Resonance $Yb^{(168)}$(n)
0.597 ev Γ_γ = 70 *5* mev

V.L.Sailor, H.H.Landon, H.L.Foote, Jr., quoted by H.H.Landon, Phys. Rev. 100, 1414 (1955).

$_{70}Yb^{171}_{101}$

ground state
J **1/2** para
$|\mu|$ **0.43** *5*
$|\mu(Yb^{173})/\mu(Yb^{171})|$ = 1.39 *1*

A.H.Cooke, J.G.Park, Proc. Phys. Soc. 69A, 282 (1956).

ground state
μ **+0.49** *6* S

K.Krebs, H.Nelkowski, Z. Phys. 141, 254 (1955).

$_{70}Yb^{173}_{103}$

ground state
J **5/2** S
μ **−0.67** *1*

K.Krebs, H.Nelkowski, Z. Phys. 141, 254 (1955). Ann. Physik 15, 124 (1954).

ground state
J **5/2** para
$|\mu|$ **0.60** *5*
$|\mu(Yb^{173})/\mu(Yb^{171})|$ = 1.39 *1*

A.H.Cooke, J.G.Park, Proc. Phys. Soc. 69A, 282 (1956).

$Yb^{175}_{70\ 105}$ 4.2^d

τ		**4.2^d** *1*	$Yb^{(174)}$(pile n,γ)	
β^-	~25†	**0.374** *30*		sd
	100†	**0.471** *3*		
$\gamma(Lu^{175})$		**0.1141**	K/L = 2.9 *4*	sπ ce
			$L_1:L_2:L_3$ = 100:41:27	M1, E2
		0.1378	K/L ~2	
		0.1450		
		0.2829	K/L_2 ~6	
		0.3970	K/L = 5.4 *3*	

J.M.Cork, M.E.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100, 1237A (1955).

$\gamma(Lu^{175})$	**0.39532** *12*		cryst

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

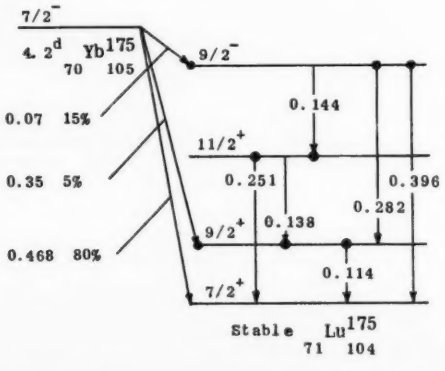
$\gamma(Lu^{175})$				sl ce,cryst
	0.11381		**0.2513**	
	0.13765		**0.28257**	
	0.14485		**0.3961**	

All γ's fitted into levels at 0.11381, 0.25146, 0.39631

F.Boehm, E.N.Hatch, P.Marmier, J.W.M.DuMond, Bull. Am. Phys. Soc. 1, No. 4, 170 E2 (1956).

β^-	15%	**0.070** *10*		sc in $\beta\gamma$
	5%	**0.350** *10*		sc in $\beta\gamma$
	80%	**0.468** *5*		sl
No 0.317β (< 0.5%)				sc in $\beta\gamma$
$\gamma(Lu^{175})$				sc in, sπ ce
	7†	**0.1136** *2*	α_K = 1.7 *4*•	
			$L_1:L_2:L_3$ = 3:1:1	E2/M1 = 0.30
	< 1†	**0.1376** *2*		
	< 2†	**0.144**		
	< 1†	**0.251**		M2/E1
	10†	**0.2824** *2*	α_K = 0.038 *10*	0.03
			K/LM ≥ 5	
	23†	**0.3960** *2*	α_K = 0.050 *5*	0.20
			K/LM = 5.8	
(0.07β)(0.282, 0.396γ)				sc in
(0.35β)(0.114γ)				
(0.144γ)(0.114, 0.138, 0.251γ)				

•From (0.282γ)(K x ray, 0.114γ)



J.P.Mize, M.E.Bunker, J.W.Starner, Phys. Rev. 100, 1390 (1955); 99, 671A (1955).

$Yb^{177}_{70\ 107}$ 1.8^h

τ		**1.88^h** *10*	$Yb^{(176)}$(pile n,γ)	
$\gamma(Lu^{177})$				
	~25†	**0.119**		sc in $\beta\gamma$
	100†	**0.148**		sc in
	~ 5†	**1.080** *5*		
	~ 5†	**1.228** *5*		
$(E_\beta > 0.5)(0.119\gamma)$				sc in
(1.080γ)(0.148γ) No (1.228γ)(0.148γ)				
Not p 6.8^dLu^{177} (expected decay, ce, and β not observed)				

J.M.Cork, M.K.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100 1237A (1955); priv. comm. 1955.

$Yb^{(176)}$(th n,γ)

β^-	4%	**0.16** *2*		sc in β(>0.7γ)
	7%	**(1.25)**		energies deduced from proposed decay scheme
	2%	**(1.28)**		
	87%	**(1.40)**		
$\gamma(Lu^{177})$			6† **0.95** *1*	sc in
	13†	**0.118** *2*	30† **1.09** *1*	
	< 10†	**0.140** *4*	~4†$^\$$ **(1.12)**	
	100†	**0.147**• *2*	27† **1.24** *1*	

•α_K < 0.4 from x/γ

(>0.7β, 0.140γ, 1.09γ)(0.147γ) delay sc in

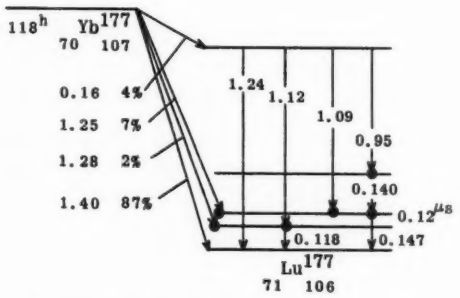
(>0.7β, >1.0γ)(0.118γ) (0.95γ)(0.140γ)

No (0.118γ)(0.147γ)

No 1.11β (<0.2%) from no β(0.140γ)

$^\$$From (>0.7γ)(0.140, 0.118γ)

β%'s from (>0.15β)(0.147γ)/β and γ intensities using α = 1.5 for 0.118γ



J.P.Mize, M.E.Bunker, J.W.Starner, Phys. Rev. 103, 182 (1956).

Lu ? 71

γ	Lu(γ,?γ)		
	0.131	$\gamma\gamma$ delay = 75$^{\mu s}$	sc in

M.G.Stewart, A.J.Bureau, C.L.Hammer, Bull. Am. Phys. Soc. 1, No. 4, 206, R2 (1956); verbal report.

$Lu^{175}_{71\ 104}$

Levels		$Lu^{(175)}(\alpha,\alpha'\gamma)$	E_α = 6; sc in
γ	**0.114** *1*	ϵB(E2) = 0.72	
	0.250 *3*	= 0.20	

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

$Lu^{175}_{71\ 104}$ Level $Lu^{(175)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.250 level

γ	100†	**0.136**	scin
	92†	**0.250**	

G.M.Temmer, N.P.Heydenburg, Bull. Am. Phys. Soc. 1, No. 1, 43, K11 (1956); verbal report.

$Lu^{176}_{71\ 105}$ Level $Lu^{(176)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

γ **0.180** *2* $\epsilon B(E2) = 1.14$

Assignment to Lu^{175} also possible

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150 (1955).

$Lu^{177}_{71\ 106}$ 6.8^d $\gamma(Hf^{177})$ **0.11308** *3* cryst

0.20786 *4*

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

$Lu^{177}_{71\ 106}$ Resonances $Lu^{(176)}(n)$ $E_n = 0.06$ to 3 ev

E_o(ev)	σ_o	Γ_γ(mev)	$g\Gamma_n$(mev)
0.143 *1*	14400	61 *2*	0.046
1.574 *6**	8300	55 *5*	0.26 *3*
2.604 *10*\$	79000	50 *1*	4.5 *1*

*Assignment to Lu^{176} possible

\$Assignment based on activation of 6.8^dLu

H.H.Landon, Phys. Rev. 100, 1414 (1955); 92, 656 (1953).

Hf 72 Relative isotopic abundances ms

Hf^{174}	**0.163%** *2*	Hf^{178}	**27.10%** *10*
Hf^{176}	**5.21%** *2*	Hf^{179}	**13.75%** *5*
Hf^{177}	**18.56%** *6*	Hf^{180}	**35.22%** *10*

No Hf^{172}, Hf^{173}, Hf^{185} ($< 2 \times 10^{-5}$%)

No Hf^{175}, Hf^{182}, Hf^{183}, Hf^{184} ($< 5 \times 10^{-5}$%)

No Hf^{181} ($< 3 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$Hf^{175}_{72\ 103}$ 70^d $\gamma(Lu^{175})$ $Hf^{174}(n,\gamma)$; scin, sπce

4†	**0.0893** *2*	
	$L_1:L_2:L_3 = 10:1:1$	E2/M1 = 0.1
	0.1136 *2*	
~1†	**0.2293** *2*	K/L~2
	0.3186 *2*	
100†	**0.3429** *2*	
	$L_1:L_2:L_3 = 10:0:0$	E2/M1 ≤ 0.25
		K/LM = 5.0
~2†	**0.4322** *2*	

(0.343γ)(K x ray, 0.089 γ) and relative photon intensities indicate ~20% ϵ to 0.432 level, ~80% ϵ to 0.343 level, <10% ϵ to g.s.

J.P.Mize, M.E.Bunker, J.W.Starner, Phys. Rev. 100, 1390 (1955).

$Hf^{175}_{72\ 103}$ 70^d $\gamma(Lu^{175})$

0.08936	sl ce,cryst
0.11381	**0.3189**
0.16133	**0.34340**
0.22957	**0.4328**

0.06169 photon interpreted as Lu $K_{\beta 5}$ x ray

All γ's fitted into levels at 0.11381, 0.34340, 0.43276, 0.50473

P.Boehm, E.N.Hatch, P.Marmier, J.W.M.DuMond, Bull. Am. Phys. Soc. 1, No. 4, 170 E2 (1956); verbal report.

$Hf^{176}_{72\ 104}$ Level $Hf^{176}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

γ **0.087** *1* $\epsilon B(E2) = 0.56$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$Hf^{177}_{72\ 105}$

	ground state	enriched Hf^{177}
J	7/2	S
μ	+**0.61** *3*	
q	+**3** *1*	

$q(Hf^{177})/q(Hf^{179}) = 0.99$ *2*

D.R.Speck, F.A.Jenkins, Phys. Rev. 101, 1831 (1956); Bull. Am. Phys. Soc. 1, No. 6, 282 C3 (1956).

Levels $Hf^{177}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

γ	**0.112** *1*	$\epsilon B(E2) = 0.77$
	0.250 *3*	$= 0.55$

H.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level $Hf^{177}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.250 level

γ	10†	**0.138**	scin
	48†	**0.250**	

G.M.Temmer, N.P.Heydenburg, Bull. Am. Phys. Soc. 1, No. 1, 43, K11 (1956); verbal report.

$Hf^{178}_{72\ 106}$ Level $Hf^{178}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

γ **0.090** *1* $\epsilon B(E2) = 0.85$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Resonances $Hf^{(177)}(n)$ $E_n = 0.5$ to 7 ev

$\sigma_o(10^3 b)$	E_o(ev)	Γ_γ(mev)	Γ_n(mev)
6.55 *12*	**1.100** *5*	67 *2*	2.10 *5*
1.35 *2*	2.39 *1*	60 *1*	9.3 *2*

Assumed g = 1/2

G.Igo, H.H.Landon, Phys. Rev. 101, 726 (1956).

$Hf^{178}_{72\ 106}$

Resonances	$Hf^{(177)}(n)$		chopper
$\sigma_o(10^3 b)$	E_o(ev)	Γ_γ(mev)	Γ_n(mev)
	(2.38)	63 *8*	7 *1*
40 *20*	**6.5** *1*	44 *20*	11 *2*

Assumed g = 1/2

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

$Hf^{179}_{72\ 107}$

	ground state	enriched Hf^{179}
J	9/2	S
μ	**−0.47** *3*	
q	**+3** *1*	

$\mu(Hf^{177})/\mu(Hf^{179}) = -1.276$ *8*
$q(Hf^{177})/q(Hf^{179}) = 0.99$ *2*

D.R.Speck, F.A.Jenkins, Phys. Rev. 101, 1831 (1956); Bull. Am. Phys. Soc. 1, No. 6, 282 C3 (1956).

Levels $Hf^{179}(\alpha,\alpha'\gamma)$ E_α = 6; scin

γ	**0.119** *1*	$\epsilon B(E2) = 0.67$
	0.260 *3*	$= 0.056$

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

Level $Hf^{179}(\alpha,\alpha'\gamma)$ E_α = 6

0.260 level

γ	100†	**0.141**	scin
	81†	**0.260**	

G.M.Temmer, N.P.Heydenburg, Bull. Am. Phys. Soc. 1, No. 1, 43, K11 (1956); verbal report.

$Hf^{180}_{72\ 108}$ 5.5^h

γ	**(0.057)***	$L_1L_2/L_3 \sim 5$	sπ ce
		$\alpha_L \sim 0.4$ E1	
80%	**(0.444)**		sl pe
20%	**0.501**		

*γ lifetime (10^{-15} single proton estimate) ascribed to K-forbiddenness ($\Delta K = 9$)

G.Scharff-Goldhaber, M.McKeown, J.W.Mihelich, Bull. Am. Phys. Soc. 1, No. 4, 206 R3 (1956); verbal report.

$Hf^{180}_{72\ 108}$ Level $Hf^{180}(\alpha,\alpha'\gamma)$ E_α = 6; scin

γ	**0.093** *1*	$\epsilon B(E2) = 0.78$

N.P. Heydenburg, G.M. Temmer, Phys. Rev. 100, 150; 98, 1198A (1955).

$Hf^{181}_{72\ 109}$ 46^d

$\gamma(Ta^{181})$ **(0.133)** E2 = 100% $ce_K\gamma(\theta)$, $\gamma\gamma(\theta)$

(0.482) E2/M1 = 34 to 55 or E2/M1 = 8 to 23

$(ce_K\ 0.133\gamma)(ce_K\ 0.482\gamma)(\theta)$* } J = 1/2, 5/2, 7/2

$(0.133\gamma)(0.482\gamma)(\theta)$

*Magnetic attenuation of angular correlation coefficients due to electron rearrangement shown

F.Gimmi, E.Heer, P.Scherrer, Helv. Phys. Acta 29, 147 (1956); 28, 470A (1955).

$Hf^{181}_{72\ 109}$ 46^d

$\gamma(Ta^{181})$ **(0.133)** E2 = 100% $ce_K\gamma(\theta)$, $\gamma\gamma(\theta)$

(0.482) E2/M1 = 43.5* $(ce_K\ 0.133\gamma)(0.482\gamma)(\theta)$ $}J = 1/2, 5/2, 7/2$

$(0.133\gamma)(0.482\gamma)(\theta)$

*Assuming no quadrupole attenuation of angular correlation coefficients

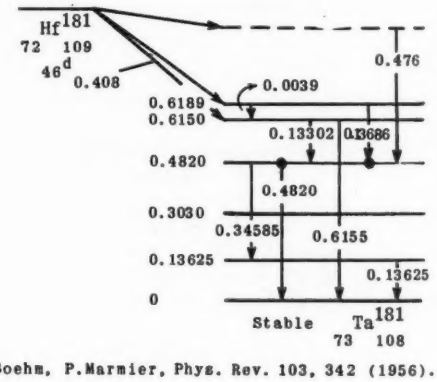
E.Heer, R.Rüetschi, F.Gimmi, W.Kündig, Helv. Phys. Acta 28, 336A (1955); F.Gimmi, E.Heer, P.Scherrer, Helv. Phys. Acta 28, 470A (1955).

$(0.133\gamma)(0.482\gamma)(\theta)$ $J = 1/2^+, 5/2^+, 7/2^+$ $\gamma\gamma(L)$

P.H.Stelson, F.K.McGowan, Bull. Am. Phys. Soc. 1, No. 5, 264 F6 (1956); F.K.McGowan, Phys. Rev. 93, 471 (1954).

$\gamma(Ta^{181})$	**0.00390** *10*		sπ, sl ce, cryst
7†	**0.13302** *2*	$\alpha_K = 0.49$	
		$L_1:L_2:L_3 = 10:48:38$	
1†	**0.13625** *2*	$\alpha_K = 1.2$	
		$L_{12}:L_3 = 10:17$	
0.3†	**0.13686** *4*	$\alpha_K = 0.9$	
2.3†	**0.34585** *20*	$\alpha_K = 0.04$	K/L = 4
~0.3†	**0.4760** *2*	$\alpha_K = 0.06$	K/L = 4.3
14†	**0.4820** *2*	$\alpha_K = 0.027$	K/L = 4.7
0.04†	**0.6155** *5*	$\alpha_K = 0.12$	

$(ce_K\ 0.13686\gamma)(0.482\gamma)$ s



F.Boehm, P.Marmier, Phys. Rev. 103, 342 (1956).

$Hf^{183}_{72\ 111}$ 64^m

τ	**64^m** *3*	$W^{(186)}$(≤32-Mev n,α)	chem
β^-	**~1.4**		a
$E_\gamma/\beta \sim 0.8$ Mev/β			GM

O.O.Gatti, J.Flegenheimer, Z. Naturf. 11a, 679 (1956).

Ta 73

Relative isotopic abundances ms

Ta^{180} **0.0123%** *3*

Ta^{181} **99.9877%** *3*

No Ta^{177}, Ta^{178}, Ta^{179} ($< 3 \times 10^{-4}$%)

No Ta^{182}, Ta^{183} ($< 2 \times 10^{-4}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956); 97, 566 (1955).

$Ta^{178}_{73\ 105}$ $22^d W^{178}$ source

No $\gamma^{\pm}$ (<1†) No 1.5γ (<1.4†) scin

No 15.4^d activity reported

†Photons per 100 $22^d W^{175}$K x ray

A. Bisi, S. Terrani, L. Zappa, Nuovo Cim. 3, 661 (1956).

$Ta^{180}_{73\ 107}$ τ $>10^{12}$y ms

From abundance of W^{180} in Ta ores

P. Eberhardt, J. Geiss, C. Lang, W. Herr, E. Merz, Z. Naturf. 10a, 796 (1955).

$Ta^{181}_{73\ 108}$

Level	$Ta^{181}(\alpha,\alpha'\gamma)$	$E_\alpha = 3.45$
γ	**(0.137)** K/L = 6.3	sπ ce

E. M. Bernstein, H. W. Lewis, Phys. Rev. 100, 1345; 99, 617A (1955).

Level	$Ta^{181}(\alpha,\alpha'\gamma)$	$E_\alpha = 3.0$
γ	**(0.137)** $\alpha_K = 1.05$ *15*	scin x/γ

F. K. McGowan, P. H. Stelson, Phys. Rev. 103, 1133 (1956).

γ	$Ta^{181}(p,p'\gamma)$	$E_p = 1.75$
0.136 *1*	$\epsilon B(E2) = 1.4$	sd ce_K
	= 0.21	ce_L
0.165 *1*	~0.2	ce_K
	~0.03	ce_L

T. Huus, J. H. Bjerregaard, B. Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Levels $Ta^{181}(p,p'\gamma)$ $E_p = 2.9$; scin

0.137 level

γ	**0.137** *3*	$B(E2) = 1.8^*$	($\alpha = 2.1$)

0.302 level

γ	**0.137** *3*		
1.6†	**0.165** *4*		
1†	**0.302** *4*	$B(E2) = 0.5^*$	($\alpha = 0.08$)

*Corrected for anisotropy

A. S. Divatia, R. H. Davis, R. D. Moffat, D. A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

Levels $Ta^{181}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin

0.136 level

γ	**0.136** *1*	$\epsilon B(E2) = 0.70$

0.303 level

γ	**0.136** *1*	
1.1†	**0.167** *2*	
1†	**0.303** *3*	$\epsilon B(E2) = 0.15$

(0.136 γ)(0.167 γ)

N. P. Heydenburg, G. M. Temmer, Phys. Rev. 100, 150 (1955); Bull. Am. Phys. Soc. 1, No. 1 43 K11 (1956); verbal report.

$Ta^{181}_{73\ 108}$

Levels $Ta^{181}(p,p'\gamma)$ $E_p = 3.7$; scin

0.137 level

γ	**(0.137)**	$B(E2) = 1.75$

0.303 level

γ	**(0.137)**	
1.4†	**(0.166)**	
1†	**(0.303)**	

(0.137 γ)(0.166 γ)

E. A. Wolicki, L. W. Fagg, E. H. Geer, Phys. Rev. 100, 1265A (1955); verbal report.

Level $Ta^{181}(p,p'\gamma)$ scin

0.303 level

γ	**(0.137)**
1.7†	**(0.166)**
1†	**(0.303)**

H. Mark, G. Paulissen, Phys. Rev. 99, 1654A (1955).

0.480 level $46^d Hf^{181}$ source

J	5/2	$\gamma\gamma(\theta)$
μ	+3.25 *17*	$\gamma\gamma(\theta,H)$

E. Heer, R. Rüetschi, F. Scherrer, Z. Naturf. 10a, 834 (1955); Helv. Phys. Acta 28, 336A (1955).

Level $Ta^{181}(\gamma,\gamma')$ $E_\gamma \leq 24$

(0.615)

$\gamma\gamma$ delay = $18.5^{\mu s}$ *25*

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).

Level $Ta^{181}(n,n'\gamma)$

(0.615)

$n\gamma$ delay = $18^{\mu s}$ *3* pulsed neutrons

E. C. Campbell, P. H. Stelson, ORNL-2076 p. 32 (1956).

γ $Ta^{181}(n,n'\gamma)$ $E_n = 2.56$ scin

$\sigma(95°)$	E_γ
36 *5*	**0.137** *2*
19 *3*	**0.164** *4*
11 *3*	**0.350** *4*
68 *9*	**0.485** *5*

σ units: mb/sterad

R. B. Day, Phys. Rev. 102, 767 (1956).

γ	$Ta^{181}(n,n'\gamma)$	$E_n = 0.35$ to 3.9 scin
0.14	**0.35**	
0.16	**0.48**	
0.21	**0.62**	

R. B. Day, A. E. Johnsrud, D. A. Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$Ta^{182}_{73\ 109}$ $^{111^d}$ g.s.

$\gamma(W^{182})$	1.1216 2			sd pe
	1.1894 2	4†	1.254 2.5	
	1.2220 2	3†	1.273 2.5	
	(1.231)	2†	(1.289)	

No 1.375, 1.437, 1.454γ (<0.3†)

G. Bäckström, Arkiv Fysik 10, 387 (1956).

$Ta^{182}_{73\ 109}$

Resonance $Ta^{181}(n)$

4.28 ev $\Gamma_\gamma = 49$ *6* mev

R.E. Wood, quoted by H.H. Landon, Phys. Rev. 100, 1414 (1955).

Resonances E_o(ev)	$Ta^{181}(n,\gamma)$	chopper
(4.28)	0.260γ observed	scin
(10.38)	0.260γ observed	
(13.95)	0.260γ not observed	

R.G. Bennett, A.E. Walters, C.A. Fenstermacher, L. Rosler, Bull. Am. Phys. Soc. 1, No. 1, 62, UA5 (1956).

Resonances	$Ta^{181}(n,\gamma)$			pulsed n's scin γ
35.5 ev	84.9			
39.2	89.4	126.2	194.5	231.8
49.1	91.1	136.2	199.4	236.4
57.5	96.7	138.1	203.8	241.8
63.0	99.0	143.9	207.9	246.6
76.7	103.3	148.1	215.4	258.4
77.5	105.3	149.4	219.3	263.0
78.7	114.7	166.0	221.6	272.2
82.7	118.0	175.1	224.5	275.7

G. Grimm, J.S. Desjardins, J. Rosen, J. Rainwater, W.W. Havens, Jr., Bull. Am. Phys. Soc. 1, No. 4, 176 F14 (1956); verbal report.

Resonances E_o(ev)	Γ_n^{o*}	$Ta^{181}(n;\ n,\gamma)$ E_o(ev)	Γ_n^{o*}	pulsed n's E_o(ev)	Γ_n^{o*}
63.2	1.0	91.1	0.38	126.0	4.3
76.7	1.6	96.7	0.43	135.9	2.0
77.5	0.74	99.0	12	138.0	1.6
78.6	0.41	103.2	0.09	143.6	0.20
82.7	1.8	105.4	3.0	148.0	0.39
84.9	0.67	114.8	4.1	149.2	0.66
89.4	0.48	118.0	0.22	165.5	0.82
*Assuming g = 1/2; units: mev				175	14

Resonances also observed at 178, 181.5, 185, 188, 194.5, 199.4, 204, 207.9, 212, 214.5, 216.3, 219.5, 221, 224.5 ev

J. Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$Ta^{182}_{73\ 109}$

Resonances E_o(ev)	$\sigma_o(10^3 b)$	$Ta^{181}(n)$ E_o(ev)	Γ_n^{o*}(mev)*	chopper Γ_γ(mev)
12 4		10.2 *1*	1.15 *19*	54 *10*
2.4 *8*		13.6 *1*	0.26 *3*	36 *8*
1.1 4		18.6 *2*	0.18 *2*	85 *20*
1.5 7		20.1 *2*	0.26 *4*	50 *15*
0.30 4		22.3 *3*	0.055 *7*	
16 7		23.7 *4*	1.8 *4*	21 *8*
		29.9 *5*	0.066 *15*	
		35.0 *6*	9.5 *3*	
		38.9 *7*	7.6 *6*	
		48 *10*	0.6 *1*	
		51.0 *5*	0.7 *1*	
		57.4 *6*	0.21 *10*	
		63.1 *15*	0.7 *3*	
		77 *1*	1.7 *9*	
		83 *2*	2.1 *4*	
		98 *2*	~10	
		105 *1.5*	8 *3*	
		114.9 *17*	9.1 *37*	
		126.5 *20*	7.2 *41*	
		135.5 *2.3*	4.9 *3*	
		173 *3*	7.4 *5*	
		197 *4*	6 *5*	
		211 *5*		
		297 *7*		

*Assuming g = 1/2

J.A. Radkevich, V.V. Vladimirsky, V.V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$Ta^{186}_{73\ 113}$ $^{10^m}$

τ	10.5^m *5*	W^{186}(20-Mev n,p) chem		
		not by W(≤28-Mev γ)		
β^-	2.2			scin
$\gamma(W^{186})$		45†	0.51	scin
25†	0.125	45†	0.61	
100†	0.200	65†	0.73	
25†	0.300	15†	0.94	
20†	0.410	≤10†	~1.1	
(2.2 β)γ				

A.J. Poë, Phil. Mag. 46, 1165 (1955).

W ? 74

γ	W(γ,n?γ)	$E_\gamma \geq 8.3$; scin	
	0.366	$\gamma\gamma$ delay = 14.6$^{\mu s}$ *3*	

M.G. Stewart, A.J. Bureau, C.L. Hammer, Bull. Am. Phys. Soc. 1, No. 4, 206 R2 (1956); verbal report.

γ	W(γ,n?γ)	$E_\gamma \leq 24$; scin	
	0.370 *15*	$\gamma\gamma$ delay = 16$^{\mu s}$ *1*	
		$\alpha \sim 0.25$	x/γ

S.H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).

W 74

τ	2.2x10^{17}y	natural W; ppl
α	3.0 2	ppl
Activity not due to mass 178 or 179		ms

W. Porschen, W. Riezler, Z. Naturf. 11a, 143 (1956).

W^{178} 74 104 22^d

τ **22.0^d** *5* Hf(52-Mev α) chem
x **100†** **K x ray** scin
No 0.27γ (<0.6†)

A.Bisi, S.Terrani, L.Zappa, Nuovo Cim. 3, 661 (1956).

W^{179} 74 105 40^m g.s.

τ **40^m** Ta^{181}(p,3n)
$\gamma(Ta^{179})$ **0.030**

T.J.Rock, Proc. Roy. Soc. Canada 50, 28A (1956).

$W^{179?}$ 74 105 $\sim 7^m$

τ **$\sim 7^m$** Ta^{181}(p,3n)
$\gamma(W^{179?})$ **0.222**

T.J.Rock, Proc. Roy. Soc. Canada 50, 28A (1956).

W^{181} 74 107 145^d

τ **145^d** *5* Hf(52-Mev α) chem
No β^+, no ce sl
No γ with $E_\gamma \sim 0.15$ ($<10^{-3}$% of K x ray)
No other γ
(L x ray)/(K x ray) = 0.39 *1*
from which $\epsilon_L/\epsilon_K = 1.54$
and $E_{dis} = 0.092$ *9*

A.Bisi, S.Terrani, L.Zappa, Nuovo Cim. 3, 661 (1956); 1, 651 (1955).

W^{182} 74 108

Level $W^{(182)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.100** *1* $\epsilon B(E2) = 2.7$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

W^{183} 74 109

Level $W^{183}(\alpha,\alpha'\gamma)$ $E_\alpha = 1.45$
γ **0.046** *1* $\epsilon B(E2) \sim 0.5$ sd ce_{MN}

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Resonance	$W^{(182)}(n)$			cryst
	E_o(ev)	σ_o	Γ_γ(mev)	Γ_n(mev)
	4.14 *3*	19000	46 *2*	1.43 *3*

H.H.Landon, Phys. Rev. 100, 1414 (1955).

W^{184} 74 110

Level $W^{(184)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.112** *1* $\epsilon B(E2) = 1.7$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

W^{185} 74 111 73^d g.s.

$\gamma(Re^{185})$
15% **~ 0.058** $\alpha \sim 3.3$ scin
Compared W^{185} $\beta\gamma/\beta$ with Tm^{170} $\beta\gamma/\beta$ using $\alpha_L = 3$ for 0.084γ of Tm^{170} and $\omega_L = 0.11$

S.K.Bhattacherjee, S.Raman, Nuovo Cim. 3, 1131 (1956).

W^{186} 74 112

Level $W^{(186)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.123** *1* $\epsilon B(E2) = 1.4$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Re 75

Resonances Re(n) E_n = 1 to 13 ev cryst

	2.156 *4**ev	
	4.416 *8*§	**11.1**
	5.90	**11.9**
	7.2	**12.8**

*Re^{186}, §Re^{188}, q.v.

G.Igo, Phys. Rev. 100, 1338; 99, 610A (1955).

Re^{185} 75 110

Level $Re^{(185)}(p,p'\gamma)$ $E_p = 1.75$
γ **0.125** *1* $\epsilon B(E2) \sim 0.3$ sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level $Re^{185}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ **0.128** $\alpha_K = 2.10$ *43* scin x/γ
p, (0.128 γ)(θ) is isotropic

F.K.McGowan, P.H.Stelson, Phys. Rev. 103, 1133 (1956).

Levels $Re^{(185)}(p,p'\gamma)$ $E_p = 3.2$; scin

0.125 level

γ **0.125** *4* B(E2) = 1.2 ($\alpha = 4.5$)

0.280 level

γ **0.125** *4*
8† **0.158** *5*
1† **0.280** *10* B(E2) = 0.5 ($\alpha = 0.15$)

R.H.Davis, A.S.Divatia, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

Levels $Re^{185}(p,p'\gamma)$ $E_p = 3.7$; scin

0.126 level

γ **0.126** B(E2) = 1.2* ($\alpha = 4.5$)

0.286 level

γ **0.126**
4.0† **0.160**
1† **0.286**
(0.126 γ)(0.160 γ)

E.A.Wolicki, L.W.Fagg, E.H.Geer, Phys. Rev. 100, 1265A (1955); *verbal report.

$Re^{186}_{75\ 111}$ 3.7^d

τ	**3.704**^{d} *84*	$Re^{(185)}$(pile n,γ)		
β^-	**0.9335*** *30*			sl $\beta\gamma$
	1.0715* *13*			sl
$\gamma(W^{186})$	**0.12267** *21*	K/L = 0.72		sl ce
		$ce_K/10^4$ β's = 43		
$\gamma(Os^{186})$		K/L = 0.65		
1000†	**0.13719** *7*	$ce_K/10^4$ β's = 430		
7.0†	**(0.627)**			scin
3.4†	**(0.764)**			

(W K x ray)/(Os K x ray) = 1.9[$] cryst
(0.934β)/(total β's) = 0.24 *1.5* sl
No β^+ (<2 x 10^{-4}%)
*F-K plot non-linear, not $\Delta J = 2$, yes shape

F.T.Porter, M.S.Freedman, T.B.Novey, F.Wagner, Jr., Phys. Rev. 103, 921 (1956); [$]P.Day, ibid.

β(0.137 γ)(θ) graph given for E_β = 0.15 to 0.80 $\eta(m)$ increases with E_β from 0.02 to 0.158 *6* scin

T.B.Novey, M.S.Freedman, F.T.Porter, F. Wagner, Jr., Phys. Rev. 103, 942 (1956); 98, 214; 99, 671A (1955).

$\gamma(Os^{186})$ **0.13722** *3* cryst

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

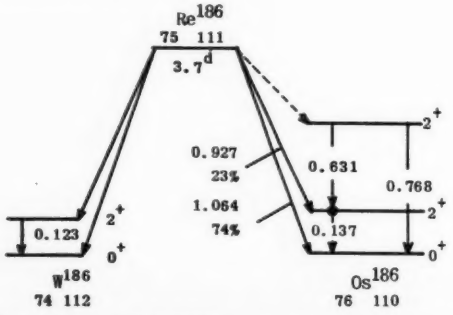
$Re^{186}_{75\ 111}$ Resonance

$Re^{(185)}$(n) cryst				
E_o(ev)	σ_o	Γ_γ(mev)	$g\Gamma_n$(mev)	
2.156 *4*	12300	55.7 *6*	3.30 *5*	

G.Igo, Phys. Rev. 100, 1338; 99, 610A (1955).

β^-	240†	**0.927** *2*	$Re^{(185)}$(pile n,γ); sd	
	760†	**1.064** *2*		
ϵ_K	32†			
$\gamma(W^{186})$	6†	**0.1229** *4*	K/L = 0.43	sd pe,ce
$\gamma(Os^{186})$				
	100†	**0.1372** *2*	K:L:MN 47:76:14	
		α_K = 0.45 from $(\beta x)/(\beta\gamma)$ = 0.43 *3*		
	0.2†	**0.6308** *8*		sd pe
	0.2†	**0.7682** *10*		
x	75†	K x rays		scin

(0.631 γ)(0.137 γ) No (0.768 γ)(0.137 γ) scin
β(0.137 γ) delay ~0.9 mμs



M.W.Johns, C.C.McMullen, I.R.Williams, S.V. Nablo, Can. J. Phys. 34, 69 (1956); Phys. Rev. 91, 418 (1953).

$Re^{187}_{75\ 112}$

Level	$Re^{(187)}$(p,p'γ)		E_p = 1.75
γ	**0.135** *1*	ϵB(E2) ~0.2	sd ce_L

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Level	Re^{187}(α,$\alpha'\gamma$)		E_α = 3.0
γ	**0.134**	α_K = 1.50 29	scin x/γ

p,(0.134 γ)(θ) is isotropic

F.K.McGowan, P.H.Stelson, Phys. Rev. 103, 1133 (1956).

Levels	$Re^{(187)}$(p,p'γ)		E_p = 3.2; scin	
	0.135 level			
γ	**0.135** *4*	B(E2) = 2.0	(α = 4.5)	
	0.300 level			
γ	**0.135** *4*			
5.4†	**0.163** *5*			
1†	**0.300** *10*	B(E2) = 0.65	(α = 0.15)	

R.H.Davis, A.S.Divatia, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

Levels	Re^{187}(p,p'γ)		E_p = 3.7; scin	
	0.135 level			
γ	**0.135**	B(E2) = 1.1*	(α = 4.5)	
	0.303 level			
γ	**0.135**			
3.8†	**0.168**			
1†	**0.303**			

(0.135 γ)(0.168 γ)

E.A.Wolicki, L.W.Fagg, E.H.Geer, Phys. Rev. 100, 1265A (1955); *verbal report.

Level	Re^{187}(p,p'γ)		scin
	0.320 level		
γ	**0.139**		
4.7†	**0.181**		
1†	**0.320**		

H.Mark, G.Paulissen, Phys. Rev. 99, 1654A (1955).

$Re^{188}_{75\ 113}$ 17^h g.s.

β^-	~1%	<1.9	$Re^{(187)}$(pile n,γ); sd		
	20%	**1.961** *2*			
	79%	**2.116** *2*			
$\gamma(Os^{188})$					sd pe,ce
	9000†	**0.1550** *2*	α_K = 0.40	(βx)/$\beta\gamma$)	
			K:L:M:N = 30:38:9:3		
			L_1:L_2:L_3 = 30:14:10		E2
	40†	**0.4536** *6*			sd pe
	630†	**0.4782** *2*	α_K = 0.06		sd pe,ce
	1000†	**0.6330** *1*	53†	**1.3079*** *7*	sd pe
	93†	**0.6726** *5*	70†	**1.6098** *8*	
	330†	**0.8280** *2*	15†	**1.7830** *7*	
	410†	**0.9310** *1*	27†	**1.8027** *8*	
	67†	**1.1328** *8*	12†	**1.959** *2*	

Continued

$Re^{188}_{75\ 113}$ 17^h g.s.

Continued

(0.155 γ)(all γ's except 0.633 and 1.959 γ)
(0.633 γ)(0.454?, 0.672?, 0.828, 1.133, 1.308 γ)
No (1.959 γ) γ
No 0.375, 1.086 γ (<10†) No 1.460 γ (<20†)
γ(0.155 γ) delay ~0.9 mμs
Proposed decay scheme accommodates all γ's
*Double

M.W.Johns, C.C.McMullen, I.R.Williams, S.V. Nablo, Can. J. Phys. 34, 69 (1956); Phys. Rev. 91, 418 (1953).

γ(Os^{188})		$Re^{(187)}$(pile n,γ)		
1010†	**0.150**	58†	**0.910**	scin
120†	**0.480**	27†	**1.130**	
160†	**0.630**	22†	**1.300**	
3†	**0.660***	21†	**1.600**	
65†	**0.820**	10†	**1.770**	

(0.48 γ)(0.15 γ)(θ) J = 2, 2, 0 & 0.48γ 99.6% E2
No (0.15 γ)(0.63 γ)
*Observed only with (0.15 γ)γ

V.R.Potnis, V.S.Dubey, C.E.Mandeville, Phys. Rev. 102, 459 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K7 (1956).

γ(Os^{188}) **0.15487** *5* cryst

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

$Re^{188}_{75\ 113}$ Resonance $Re^{(187)}$(n) cryst

E_o(ev)	σ_o	Γ_γ(mev)	$g\Gamma_n$(mev)
4.416 *8*	1560	45 *1*	0.32 *1*

G.Igo, Phys. Rev. 100, 1338; 99, 610A (1955).

Os_{76} No α's $\tau > 1x10^{17y}$ for $1.5 < E_\alpha < 2.5$; ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

Resonances Os(n) chopper

E_o(ev)	$g\Gamma_n$(mev)	Γ_γ(mev)
6.73 *8*	0.197 *25*	67 *10*
8.85 *11*	0.745 *90*	67 *10*
10.30 *15*	0.31 *4*	86 *14*
12.6 *2*	0.11 *2*	
18.8 *3*	0.70 *7*	44 *10*
22.0 *4*	1.86 *22*	62 *14*
27.9 *6*	3.17 *55*	
38.8 *10*	7.0 *10*	
41.2 *10*	0.55 *8*	
44.3 *10*	4.8 *12*	

Continued

Os_{76} Continued

50.6 *14*	7.1 *16*		
55.8 *18*	5.4 *15*		
63.1 *20*	22 *5*		
66.4 *20*	3.9 *9*		
78.2 *30*	62 *22*		
89.9 *40*	42 *17*		

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Os^{185}_{76\ 109}$ 97^d γ(Re^{185}) **0.0725** scin, sl ce
0.125
0.162 **0.647**
0.234 **0.875**

C.H.Pruett, R.G.Wilkinson, Phys. Rev. 100, 1237A (1955).

$Os^{190}_{76\ 114}$ 10^m τ **10^m** 2 d 3.2^h Ir^{190} chem

γ	75†	**0.186**	scin
	90†	**0.356**	
	100†	**0.510**	
	92†	**0.620**	
x	23†	**K x ray**	

0.186, 0.356, 0.510, 0.620 γ's in 4-fold coinc.

A.H.W.Aten, Jr., G.D.de Feyfer, W.J.Sterk, A.H.Wapstra, Physica 21, 740, 990 (1955).

Ir_{77} No α's $\tau > 1x10^{17y}$ for $1.5 < E_\alpha < 2.5$; ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

Resonances Ir(n) E_n = 0.45 to 30 ev

E_o(ev)	E_o(ev) cryst
0.654 *2**	
1.303 *5*§*	**9.9**
5.36 *4**	~19.5
6.1	~25.5
9.03	~31

*Ir^{192}, §Ir^{194}, q.v.

H.H.Landon, Phys. Rev. 100, 1414 (1955); 99, 610A (1955).

Resonances Ir(n) chopper

E_o(ev)	$g\Gamma_n$(mev)	Γ_γ(mev)
5.36	3.4 *13*	31 *14*
6.125	0.15 *1*	44 *7*
9.05	1.84 *25*	57.5 *86*

Continued

Ir 77

Continued

E_o(ev)	$g\Gamma_n$*	E_o(ev)	$g\Gamma_n$*	E_o(ev)	$g\Gamma_n$*
9.89	0.14 *1*	24.25	24 *5*	50.8	52 *17*
10.4	0.049 *5*	29.2	7 *1*	61.2	22 *4*
10.8		30.6	2.4 *5*	66.3	51 *11*
11.2		35.2	0.9 *2*	75.6	69 *17*
18.7	0.81 *16*	39.7	4 *2*	93.5	141 *38*
19.65	0.61 *10*	41.7	37 *9*		

*units: mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Ir^{190}_{77\ 113}$ 3.2^h β^+ 2.04 *7* $Ir^{(191)}$ (fast n,2n) chem scin

p 10^mOs chem

A.H.W.Aten, Jr., G.D.de Feyfer, M.J.Sterk, A.H.Wapstra, Physica 21, 740, 990 (1955).

$Ir^{191}_{77\ 114}$ Levels $Ir^{(191)}$(p,p'γ) E_p = 3.2; scin

0.133 level

γ 0.133 *4* B(E2) = 0.8 (α = 4.4)

0.356 level

γ 0.133 *4*

1.1† 0.216 *6*

1† 0.356 *8* B(E2) = 0.9 (α = 0.04)

R.H.Davis, A.S.Divatia, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

$Ir^{192}_{77\ 115}$ 74^d g.s. β^- <0.5%* (0.100)* $Ir^{(191)}$(pile n,γ)

7%* (0.257)*

41%* (0.537)* 48%* 0.673 *10* sd

No β^+ (< 10^{-4}%) cryst $\gamma^{\pm}$

ϵ 3.5%* sd ce,cryst

$\gamma(Os^{192})$

			α_K	α_{L1L2}	α_{L3}
4.6†	0.20131	*4*	0.30	0.12	0.07
39†	0.20575	*4*	0.16	0.077	0.04
6†	0.28335	*20*	0.04		
19†	0.3747	*5*			
39†	0.48475	*23*	0.022		
0.5†	1.060	*30*			

$\gamma(Pt^{192})$

1.9†	0.13633	*2*	1.0	0.63	0.44
360†	0.29594	*9*	0.065	0.025	0.006
350†	0.30845	*9*	0.069	0.028	0.008
1000†	0.31646	*9*	(0.054)§	0.018	0.006
16†	0.4166	*7*	0.019		
640†	0.46798	*22*	0.022	0.0052	0.001
71†	0.5884	*6*	0.011	0.0031	
140†	0.6045	*9*	0.016	0.0031	
84†	0.6129	*9*	0.011	0.0023	
1†	0.785	*20*			
5†	0.885	*2*	0.007		

(0.468γ)(0.316γ)(θ) J = 4, 2, 0

(0.588γ)(0.613γ)(θ) J = 4, 2, 0

(~0.30γ)(0.885γ)

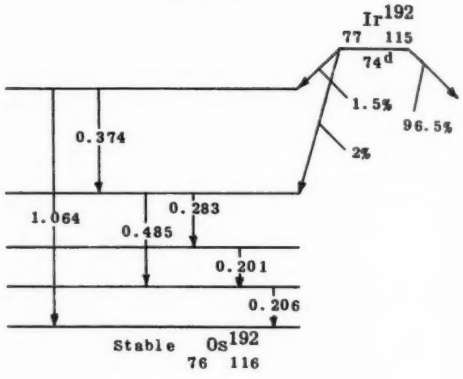
*Not measured, determined from γ transitions

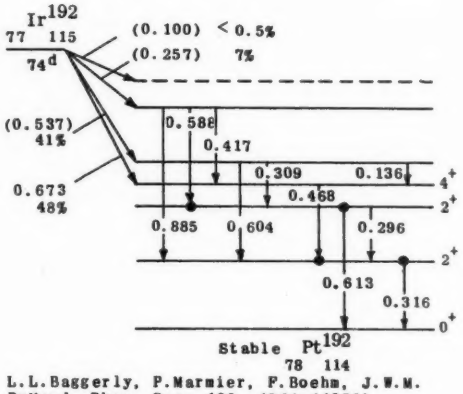
§α's based on this theoretical α_K(E2)

Continued

$Ir^{192}_{77\ 115}$ 74^d g.s.

Continued





L.L.Baggerly, P.Marmier, F.Boehm, J.W.M. DuMond, Phys. Rev. 100, 1364 (1955).

$\gamma(Os^{192})$ 0.282 $Ir^{(191)}$(pile n,γ)

0.4840 sd pe,ce

$\gamma(Pt^{192})$

0.2870	0.4380
0.2940	0.4675
0.3080	0.5900
0.3160	0.6040
0.4190	0.6130

γ(?) 0.430

0.4226 Pb pe ascribed to $\gamma^{\pm}$

Electrons studied in energy range 0.18 to 0.55

F.Grard, L.Danguy, J.Franeau, J. phys. radium 16, 839 (1955).

$\gamma(Os^{192})$

0.58† 1.053 sπ Cp

$\gamma(Pt^{192})$

445†	0.29 to 0.32
256†	(0.468)
100†	0.58 to 0.62
2.07†	(0.885)

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No. 1, 49 (1956).

$\gamma(Pt^{192})$ 0.29596 *10* cryst

0.30866 *6*

0.31652 *4*

0.46795 *12*

N.Ryde, B.Andersson, Proc. Phys. Soc. 68B, 1117 (1955).

$Ir^{192}_{77\ 115}$ 74^{d} g.s.

$(\sim 0.3\,\gamma)(\sim 0.3\,\gamma)(\theta)$ scin
$(0.468\,\gamma)(0.316\,\gamma)(\theta)$
$(0.588\gamma)(0.613\gamma)(\theta)$
Consistent with J = 2 to 5, 2 to 5, 4(3),2,2,0 for Pt^{192} levels at 1.201, 0.920, 0.784, 0.613, 0.316, g.s.

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

$(0.604\,\gamma)(0.316\,\gamma)(\theta)$ J = 3, 2, 0

V.W.Shiel, L.D.Wyly, C.H.Braden, Bull. Am. Phys. Soc. 1, No. 5, 264 F7 (1956).

$Ir^{192}_{77\ 115}$ Resonances $Ir^{(191)}(n)$ E_n = 0.45 to 6 ev

E_o(ev)	σ_o	Γ_γ(mev)	$g\Gamma_n$(mev)
0.654 2	13800	73.5 *10*	0.25 *1*
5.36 4	24000	67 *5*	3.6 2

$19^{h}Ir^{194}$ not produced at these resonances

H.H.Landon, Phys. Rev. 100, 1414 (1955); 99, 610A (1955).

$Ir^{193}_{77\ 116}$ Levels $Ir^{(193)}(p,p'\gamma)$ E_p = 3.2; scin

0.143 level
γ **0.143** 4 B(E2) = 1.0 (α = 4.4)
0.368 level
γ **0.143** 4
0.3† **0.230** 6
1† **0.368** 8 B(E2) = 0.35 (α = 0.04)

R.H.Davis, A.S.Divatia, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

$Ir^{194}_{77\ 117}$ Resonance $Ir^{(193)}(n)$ E_n = 0.45 to 6 ev

E_o(ev)	σ_o	Γ_γ(mev)	$g\Gamma_n$(mev)
1.303 5	10400	86.5 *10*	0.46 *1*

Assignment based on activation of $19^{h}Ir$ cryst

H.H.Landon, Phys. Rev. 100, 1414 (1955); 99, 610A (1955).

Pt_{78} Relative isotopic abundances ms

Pt^{190}	**0.0127%** 5	Pt^{195}	**33.8%** *1*
Pt^{192}	**0.78%** *1*	Pt^{196}	**25.2%** *1*
Pt^{194}	**32.9%** *1*	Pt^{198}	**7.19%** 4

No Pt^{188} (< 0.0013%)
No Pt^{189}, Pt^{191} (< 0.0005%)
No Pt^{193}, Pt^{197}, Pt^{199}, Pt^{200} (< 0.001%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Pt_{78} "$82^{d}Pt$" identified as $76^{d}Ir^{192}$ chem, scin γ

G.W.Warren, R.W.Fink, Bull. Am. Phys. Soc. 1, No. 4, 171 E4 (1956).

$Pt^{190}_{78\ 112}$? $9.6x10^{11y}$ τ **$9.6x10^{11y}$** 5 natural Pt ppl
α **3.3** 2 ppl
*Using 0.012% for abundance of Pt^{190}

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956); 9a, 701 (1954).

$Pt^{191}_{78\ 113}$ 3.0^{d} Pt^{190}(pile n,γ) chem
(0.130 γ)(0.220, 0.409 γ) scin
($\sim$0.175 γ)($\sim$0.175, 0.355 γ)

V.R.Potnis, C.E.Mandeville, J.S.Burlew, Phys. Rev. 101, 753 (1956).

$Pt^{192}_{78\ 114}$ $\sim 10^{15y}$ τ $\sim 10^{15y}$ natural Pt ppl
α $\sim$**2.6** ppl

W.Porschen, W.Riezler, Z. Naturf, 11a, 143 (1956).

$Pt^{193}_{78\ 115}$ g.s. τ **$< 500^{y*}$** Pt^{192}(pile n,γ) chem
ϵ_L a,pc L x ray
$\epsilon_K/\epsilon_L < 0.001$ from absence of K x ray pc
No γ, no particles pc,scin
*Assuming σ = 0.08

R.A.Naumann, Bull. Am. Phys. Soc. 1, No. 1, 42, K9 (1956).

$Pt^{193}_{78\ 115}$ 4.5^{d} Pt^{192}(pile n,γ) chem
γ **0.130** scin
No γ with $E_\gamma > 0.7$ (< 0.03%)

V.R.Potnis, C.E.Mandeville, J.S.Burlew, Phys. Rev. 101, 753 (1956).

$Pt^{195}_{78\ 117}$ $\sim 6^{d}$ Pt^{194}(pile n,γ) chem
γ **0.031** scin
0.099
0.130
(K x ray)(K x ray, 0.099, 0.130 γ)
(0.031 γ)(0.099 γ) No (0.099 γ)(0.130 γ)

V.R.Potnis, C.E.Mandeville, J.S.Burlew, Phys. Rev. 101, 753 (1956).

$Pt^{195}_{78\ 117}$ Levels $Pt^{(195)}(\alpha,\alpha'\gamma)$ E_α = 4.0

0.029 level
γ **0.029** scin γ
0.126 level B(E2) $\sim$ 0.5*
γ **0.097** sπ ce

Continued

Pt^{195} 78 117

Continued

	0.210 level	B(E2) = 0.5*	
γ	**0.210**	K/L = 6	sπ ce
	0.240 level		
γ	**(0.240)**	$\alpha_K < 0.2$ E2	sπ ce

*Used B(E2) = 0.334 for 0.279 Au^{197} level

E.M.Berstein, H.W.Lewis, Phys. Rev. 100, 1345 (1955).

Level		$Pt^{(195)}(p,p'\gamma)$	E_p = 1.75
γ	**0.210** 2	$\epsilon B(E2) \sim 0.15$	sd ce_K

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Pt^{197} 78 119 18^h g.s.

β^-	**0.468**	Pt^{196}(pile n,γ) chem	
	0.479	**0.670**	scin $\beta\gamma$
$\gamma(Au^{197})$			
30†	**0.077**		scin
3.9†	**0.191**	$\alpha_K \sim 2.5$*	
1†	**0.279**		

(0.468β)(0.279γ) (0.479β)(0.191γ)
(0.670β)(0.077γ) No 0.55γ
(0.077γ)(K x ray, 0.191γ) No (0.279γ)γ
*From (x)(0.077γ)/(x)(0.191γ)

V.R.Potnis, C.E.Mandeville, J.S.Burlew, Phys. Rev. 101, 753 (1956); 99, 671A (1955).

Pt^{197} 78 119

Levels Au^{197}(n,p) E_n = 14; ppl

Level	Γ
100† **g.s.**	1.1
55† **1.53** *15*	1.0
47† **2.52** *15*	1.2
45† **3.96** *15*	0.9
22† **5.77** *15*	1.2
16† **7.22** *15*?	1.0

R.A.Peck, Jr., Bull. Am. Phys. Soc. 1, No. 1, 40, JA8 (1956); verbal report.

Pt^{200} 78 122

τ $<4^d$ or $>2^y$ Pt(pile n) chem
No activity observed with $\tau > 4^d$

G.W.Warren, R.W.Fink, Bull. Am. Phys. Soc. 1, No. 4, 171 E4 (1956); AECU-3165 (1956); priv. comm.

Au^{194} 79 115 39^h

β^+	1.7†	**1.21** 2		sl $\beta(0.30\gamma)$
	1.3†	**1.55** 2		sl
$\gamma(Pt^{194})$			α_K	
	26†	**0.2913** 5	0.062 7	sl ce
	100†	**0.3267** 5	0.056 6	
	20†	**0.640** *20*		scin
	9†	**0.940** *20*		
	6†	**1.120** *20*		sl ce

Continued

Au^{194} 79 115 39^h

Continued

$\gamma(Pt^{194})$			α	
6†	**1.160** *20*	0.003 *1*		
<2†	**1.230** *20*			
~2†	**1.270** *20*	0.004 *2*		
2†	**1.340** *20*	0.007 *3*		
8†	**1.470** *5*	0.010 *2*		
~1†	**~1.50**			(0.64γ)γ
6†	**1.590** *20*	0.003 *1*		sl ce
7†	**1.890** *15*	0.0014 *4*		
5†	**2.050** *15*	0.0018 *5*		
~1†	**2.150** *15*	0.013 *5*		
~0.6†	**~2.30**			scin

(ce_K 0.291γ)(0.327, 0.64, 0.94, 1.16, 1.47, 1.59γ)
(ce_K 0.327γ)(0.291, 0.64, 0.94, 1.16, 1.47, 1.59, 1.89γ)
(0.30γ)(0.30, 0.64, 0.94, 1.16, 1.47, 1.59, 1.89γ)
(0.64γ)(0.30, 0.64, 0.94, 1.16, 1.34, 1.50, 1.59γ)
(0.94γ)(0.30, 0.64, 0.94γ)
Decay scheme proposed

M.T.Thieme, E.Bleuler, Phys. Rev. 102, 195 (1956); 99, 1646A (1955).

$\gamma(Pt^{194})$	**0.290**	~130^dHg source; sl ce_K	
	0.330		
	~1.5		(ce_K)γ
	~2		scin
(ce_K 0.290γ)(0.330, ~1.5γ)			sl, scin
(ce_K 0.330γ)(0.290, ~1.5γ)			

J.Brunner, H.Guhl, J.Halter, H.J.Leisi, Helv. Phys. Acta 28, 475A (1955).

Au^{195} 79 116 185^d g.s.

$\gamma(Pt^{195})$ 1†	**0.031**	$Pt^{(194)}$(15-Mev d,n)		
12†	**0.099**	2†	**0.130**	scin

(0.099γ)(K x ray, 0.031γ)
(K x ray)(0.130γ) No (0.099γ)(0.130γ)

V.R.Potnis, Bull. Am. Phys. Soc. 1, No. 4, 170 E3 (1956); verbal report.

$\gamma(Pt^{195})$	**0.130**	sl ce

J.Brunner, H.Guhl, J.Halter, H.J.Leisi, Helv. Phys. Acta 28, 475A (1955).

Au^{195} 79 116 30^s

γ			40^hHg^{195} source
87*	**0.0565**	$\alpha \sim \infty$	scin; sπ, sl ce
		$L_2 : L_3 : M = 34 : 32 : 22$	
19.9*	**0.2615**	$\alpha = 0.25$ *3*	
		K : L : M = 16 : 3 : 0.85	
0.25*	**0.318**	(ce_{LM} only)	

*Relative ce intensities

R.Joly, J.Brunner, J.Halter, O.Huber, Helv. Phys. Acta 28, 403 (1955); 26 591A (1953).

$Au^{196}_{79\ 117}$ 5.6^d

β^- 12%* Pt(9.5-Mev d) chem; sl pe,ce

$\gamma(Pt^{196})$			α_K	K/LM
	28†	**0.3310** 4	0.059 4	2.0
	100†	**0.3340** 4	0.042 3	1.9
$\gamma(Hg^{196})$		**(0.426)**		

$(0.331\gamma)(ce_K\ 0.354\gamma)$ $(ce_K\ 0.331\gamma)(ce\ 0.354\gamma)$

*From ratio $(ce_{LM}\ 0.426\gamma)/(ce_K\ 0.354\gamma)$ and measured α's

M.T.Thieme, E.Bleuler, Phys. Rev. 101, 1031 (1956); 99, 1646A (1955).

$\gamma(Pt^{196})$	**0.330**	Au^{197}(33-Mev p,d)	chem
	0.360		scin
$\gamma(Hg^{196})$	**0.430**		

$(0.330\gamma)(0.360\gamma)$

$\beta(0.430\gamma)$

J.Brunner, H.Guhl, J.Halter, H.J.Leisi, Helv. Phys. Acta 28, 475A (1955).

$Au^{197}_{79\ 118}$ 7.4^s

Au^{197}(n,n'), d $23^h Hg^{197}$; sl ce

γ	402*	**0.130**	K : L : M = 30.5 : 268 : 104 L_2/L_3 = 1.3 $\alpha \sim 0.8$
	124*	**0.277**	K : L : M = 100 : 19 : 4.7 α_K = 0.29 3
	1.4*	**0.407**	K/LM = 2.3 $\alpha_K \geq 1.5$

$(ce\ 0.130\gamma)(0.277\gamma)$ sl,scin

$(0.277\gamma)/(0.407\gamma) \geq 500$ scin

*Relative ce intensities

R.Joly, J.Brunner, J.Halter, O.Huber, Helv. Phys. Acta 28, 403 (1955); 26, 591A (1953).

γ	**(0.279)**	E2/M1 = 0.12 3 or 2.0 3	$\gamma\gamma(\theta)$
$(0.130\gamma)(0.279\gamma)(\theta)$		J = 11/2, 5/2, 3/2	

J.V.Kane, S.Frankel, Bull. Am. Phys. Soc. 1, No. 4, 171 E9 (1956).

$Au^{197}_{79\ 118}$

Levels $Au^{197}(\alpha,\alpha'\gamma)$ E_α = 3.25

	0.077 level	B(E2) = 0.18*	sπ ce
γ	**0.077**		
	0.268 level	B(E2) 0.13*	
γ	**0.191**		
	0.279 level		
γ	**0.279**	K/L = 5.5	

*Used B(E2) = 0.334 for 0.279 level

E.M.Bernstein, H.W.Lewis, Phys. Rev. 100, 1345; 99, 617A (1955).

Level	$Au^{197}(p,p'\gamma)$	E_p = 2.00
γ	**0.281** 3 $\epsilon B(E2) \sim 0.07$	sd ce_K

T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$Au^{197}_{79\ 118}$

Level $Au^{197}(\alpha,\alpha'\gamma)$ E_α = 3.0

γ	**0.277**	E2/M1 = 0.30 7	$\alpha,\gamma(L)$

F.K.McGowan, P.H.Stelson, Phys. Rev. 103, 1133 (1956).

γ		$Au^{197}(p,p'\gamma)$		E_p = 3.8
	7.9*	**0.1913** 8	K/L = 4.2	sπ ce
	1.9*	**0.2698** 11	K/L = 6	
	18.3*	**0.2795** 11	K : L : MN = 20 : 3.1 : 1	
	0.5*	**0.5477** 20	K/L = 3.6	

*$\sigma(90°)$ for ce_K in μb/sterad

M.S.Moore, C.M.Class, F.W.Prosser, Jr., J.P. Schiffer, Bull. Am. Phys. Soc. 1, No. 2, 88, H2 (1956).

γ	$Au^{197}(n,n'\gamma)$	E_n = 0.35 to 3.9	
	0.20		scin
	0.28		
	0.50		

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$Au^{198}_{79\ 119}$

	ground state	Au^{197}(pile n,γ)
J	2	M
$\lvert\mu\rvert$	**0.50** 4	

R.L.Christensen, D.R.Hamilton, A.Lemonick, F.M.Pipkin, J.B.Reynolds, H.H.Stroke, Phys. Rev. 101, 1389 (1956); 99, 613A (1955).

$Au^{198}_{79\ 119}$ 2.7^d

τ	**2.694**^{d} 6	Au^{197}(pile n,γ)

C.Sastre, G.Price, Nuclear Sci. Eng. 1, 325 (1956).

τ	**2.686**^{d} 5	differential ic

J.Tobailem, Ann. Phys. 10, 783 (1955); J.phys. radium 16, 48 (1955).

τ	**2.697**^{d} 5	Au^{197}(slow n,γ)

K.E.Johansson, Arkiv Fysik 10, 247 (1956).

			Au^{197}(pile n,γ)
β^-	**0.960** 2	FK linear ($E_\beta > 0.3$)	sl

F.T.Porter, M.S.Freedman, T.B.Novey, F. Wagner, Jr., Phys. Rev. 103, 921 (1956).

$Au^{198}_{79\ 119}$ 2.7^d

$\gamma(Hg^{198})$ **0.41176** *19* $\alpha_K = 0.025$ *5* EA,
$\alpha_L = 0.012$ *2* ce/β^*
$L_1 : L_2 : L_3 = 19 \pm 3 : 22 \pm 3 : 10$
*Total β's found from β background count at ce energy and theory of allowed β shape

D.R.Connors, W.C.Miller, B.Waldman, Phys. Rev. 102, 1584 (1956); 100, 1237A (1955).

$\gamma(Hg^{198})$ **(0.411)** $L_1L_2/L_3 = 5.9$ s
$K : L : M : N = 100 : 36 : 10 : 2.7$

R.D.Birkhoff, W.W.Smith, H.H.Hubell, Jr., J.S.Cheka, Rev. Sci. Instr. 26, 959 (1955).

$\gamma(Hg^{198})$

100†	**(0.411)**	sπ Cp
1.11†	**(0.676)**	
0.28†	**(1.089)**	

B.S.Dželepov, J.V.Hol'nov, Nuovo Cim. 3, Suppl. No.1, 49 (1956).

$Au^{198}_{79\ 119}$ Capture γ's $Au^{197}(n,\gamma)$ cryst

0.261		**0.328**	
0.271		**0.343**	double
0.276		**0.350**	
0.291	double	**0.354**	
0.308		**0.370**	double
0.311		**0.381**	
0.316		**0.439**	

Study covered $E_\gamma = 0.260$ to 0.440

D.Rose, B.Hamermesh, Bull. Am. Phys. Soc. 1, No. 4, 189 K13 (1956); verbal report.

Capture γ Au^{197}(th n,γ)
0.248 *13* scin Cp
Study covered $E_\gamma = 0.1$ to 2.5

M.Reier, M.H.Shamos, Phys. Rev. 100, 1302 (1955); 95, 636A (1954).

Resonance Au^{197}(n)

E_o(ev)	Γ_n(mev)	Γ_γ(mev)
61	86 *24*	170 *80*

Assumed g = 1/2

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

$Au^{199}_{79\ 120}$

	ground state	$Pt^{(198)}$(pile n,$\gamma\beta$)
J	3/2	M
$\lvert\mu\rvert$	**0.24** *2*	

R.L.Christensen, D.R.Hamilton, A.Lemonick, F.M.Pipkin, J.B.Reynolds, H.H.Stroke, Phys. Rev. 101, 1389 (1956); 99, 613A (1955).

$Au^{199}_{79\ 120}$ 3.1^d τ **3.148^d** *10* $Pt^{(198)}$(n,$\gamma\beta$) chem

R.E.Bell, R.L.Graham, L.Yaffe, Can. J. Phys. 33, 457.

Hg 80 Resonances Hg(n) chopper

E_o(ev)	Isotope	E_o(ev)	Isotope
23	199		
34	200	**128**	
43	202	**177**	200
73	200?	**206**	
90	199?	**311**	199?

Assignments by use of enriched isotopes

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Hg^{192}_{80\ 112}$ 5.7^h τ **6.3^h** Bi^{209}(480-Mev p) chem

A.P.Vinogradov, I.P.Alimarin, V.I.Baranov, A.K.Lavrukhina, T.V.Baranova, F.I.Pavlotskaya, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 132 July (1955); Consultants Bureau Trans. p. 85.

$Hg^{193}_{80\ 113}$ 12^h τ **11^h** Bi^{209}(480-Mev p) chem

A.P.Vinogradov, I.P.Alimarin, V.I.Baranov, A.K.Lavrukhina, T.V.Baranova, F.I. Pavlotskaya, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p.132 July (1955); Consultants Bureau Trans. p. 85.

$Hg^{193}_{80\ 113}$ $12^h + 4^h$ $\gamma(Au^{193})$

(0.032)	**0.360**	sπ,sl ce	
(0.038)	**0.364**		
0.157	**0.3812**	**0.920**	
(0.186)	**0.382**	**1.120**	
(0.218)	**0.394**	**1.170**	
0.220	**0.407**	**1.240**	
(0.258)	**0.499**	**1.320**	
(0.291)	**0.534**	**1.490**	
0.300	**0.571**	**1.630**	
0.345	**0.860**		

(0.218γ)(~0.40γ) (0.038γ)(0.220γ)

J.Brunner, H.Guhl, J.Halter, H.J.Leisi, Helv. Phys. Acta 28, 475A (1955).

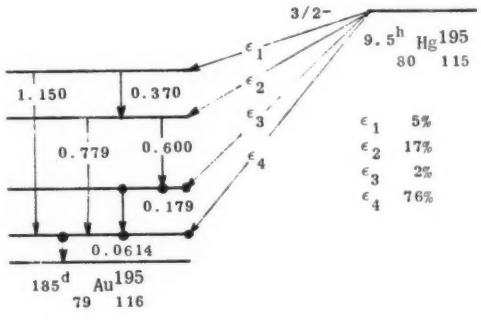
$Hg^{194}_{80\ 114}$ ~130^d g.s. τ **~130^d** Au^{197}(55-Mev p,4n) chem
No γ sl ce,scin
γ's observed assigned to 39^hAu

J.Brunner, H.Guhl, J.Halter, H.J.Leisi, Helv. Phys. Acta 28, 475A (1955).

$Hg^{195}_{80\ 115}$ 9.5^h g.s.

τ	**9.5^h** *5*	Au^{197}(27-Mev d,4n) chem	
$\gamma(Au^{195})$	**0.0614**	L/M = 3.5	sπ,sl ce
		$L_1 : L_2 : L_3$ = 1.1 : 1 : 1	
		$\alpha \sim \infty$	
	0.179	α_K = 0.85 *15*	
4.5+	**0.390** *20*		
31+	**0.600**	$\alpha_K \sim 0.02$	
	0.779	α_K = 0.013	K/LM = 4.5
	0.930 *50*		
22+	**1.150**		

$(ce_L\ 0.061\gamma)(K\ x\ ray, 0.179, 0.60, 0.779, 1.150\gamma)$
$(ce_K\ 0.179\gamma)(K\ x\ ray, 0.390, 0.60, 0.930\gamma)$

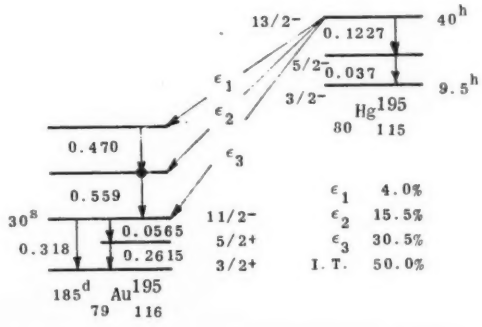


R. Joly, J. Brunner, J. Halter, O. Huber, Helv. Phys. Acta 28, 403 (1955); 26, 591A (1953); 27, 512A, 572 (1954).

$Hg^{195}_{80\ 115}$ 40^h

τ	**40.0^h** *5*	Au^{197}(27-Mev d,4n) chem	
$\gamma(Hg^{195})$	**0.037**	$L_1/L_2 \sim 10$	sπ,sl ce
		L : M : N = 60 : 20 : 11	
		$\alpha \sim \infty$	
	0.1227	$L_1 : L_2 : L_3$ = 10 : 3 : 19	
		K : L : MN = 11 : 50 : 23	
		$\alpha \geq 24$	
$\gamma(Au^{195})$			scin,sl ce
34+	**0.470** *5*		
229+	**0.559**	K : L : M = 50 : 9.3 : 2.3	
14+	**~1.03**		scin

$(ce_K\ 0.559\gamma)(K\ x\ ray,\ 0.470\gamma)$



R. Joly, J. Brunner, J. Halter, O. Huber, Helv. Phys. Acta 28, 403 (1955); 26, 591A (1953); 27, 512A, 572 (1954).

$Hg^{195}_{80\ 115}$ $40^h + 9.5^h$

$\gamma(Au^{195})$	**0.172**	sπ,sl ce
	0.2005	**0.810**
	0.207	**0.920**
	0.368	**0.955**
	0.388	**1.010**
	0.439	**1.120**
	0.525	**1.180**
	0.584	**1.255**

$(0.388\gamma)(0.368\gamma)(0.207\gamma)$ $(0.179\gamma)(0.920\gamma)$
$(ce\ 0.262\gamma)/(ce\ 0.2005\gamma) \sim 100$
Only new γ's are listed; source: $40^h + 9.5^h$ Hg

J. Brunner, H. Guhl, J. Halter, H. J. Leisi, Helv. Phys. Acta 28, 475A (1955).

$Hg^{197}_{80\ 117}$ 65^h g.s.

$\gamma(Au^{197})$		Au^{197}(27-Mev d,2n) chem	
1060*	**0.0776**	$\alpha \sim 2.3$	sπ,sl ce
		$L_1 : L_2 : L_3$ = 100 : 46 : 34	
		L : M : N = 831 : 176 : 53	
8.62*	**0.1918**	α_K = 0.90 *10*	
		K : L : M = 7.2 : 1.1 : 0.34	

$(ce\ 0.077\gamma)(K\ x\ ray,\ ce\ 0.191\gamma,\ 0.191\gamma)$
*Relative ce intensities

R. Joly, J. Brunner, J. Halter, O. Huber, Helv. Phys. Acta 28, 403 (1955); 26, 591A (1953).

$Hg^{197}_{80\ 117}$ 23^h

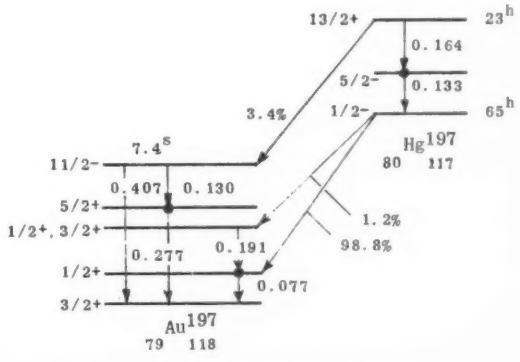
γ	**(0.133)**	E2 = 100%	$ce_K\gamma(\theta)$
	(0.164)	E5/M4 ≤ 0.01	

$(ce_L\ 0.164\gamma)(ce_L\ 0.133\gamma)(\theta)$
$(ce_K\ 0.164\gamma)(0.133\gamma)(\theta)$* J = 13/2, 5/2, 1/2
*Magnetic attenuation of correlation coefficients due to electron rearrangement shown

F. Gimmi, E. Heer, P. Scherrer, Helv. Phys. Acta, 29, 147 (1956); 28, 470A (1955).

$(ce_K\ 0.164\gamma)(ce_K\ 0.133\gamma)(\theta)$ studied scin
Attenuation of angular correlation coefficients attributed to Al source-backing

E. Breitenberger, Proc. Phys. Soc. 69A, 566 (1956).



R. Joly, J. Brunner, J. Halter, O. Huber, Helv. Phys. Acta 28, 403 (1955); 26, 591A (1953).

$Hg^{198}_{80\ 118}$

Level	$Hg^{198}(p,p'\gamma)$	$E_p = 4.5$; scin
γ	**(0.411)** $\tau = 20^{\mu\mu s}$	($\alpha = 0.04$)

R. Barloutaud, T. Grjebine, M. Riou, Compt. rend. 242, 1284 (1956).

Level	$Hg^{(198)}(p,p'\gamma)$	$E_p = 3.2$; scin
γ	**(0.411)** $\tau = 60^{\mu\mu s}$	($\alpha = 0.04$)

R. H. Davis, A. S. Divatia, R. D. Moffat, D. A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

$Hg^{199}_{80\ 119}$ 44^m

	0.159 level	$Hg^{(199)}$(pile n,n')
$\lvert q \rvert$	0.70^{*+40}_{-15}	$HgCl_2$ $\gamma\gamma(\theta)$
γ	**(0.159)** E2 = 100%	liquid Hg
	(0.368) E5/M4 ~ 0.008	$\gamma\gamma(\theta)$

*Using $eq(\partial^2V/\partial z^2)/h = 708$ Mc/sec for Hg^{201}(1) and $q(Hg^{201}) = 0.45$ (2)

R. V. Pound, G. K. Wertheim, Phys. Rev. 102, 396 (1956). (1) H. G. Dehmelt et al., Phys. Rev. 93, 480 (1954). (2) K. Murakawa, Phys. Rev. 98, 1285 (1955).

$Hg^{199}_{80\ 119}$

Levels	$Hg^{199}(p,p'\gamma)$	$E_p = 4.5$; scin
γ	**(0.159)**	B(E2) = 0.32 ($\alpha = 0.65$)
	(0.209)	B(E2) = 0.12 ($\alpha = 0.70$)

R. Barloutaud, T. Grjebine, M. Riou, Compt. rend. 242, 1284 (1956).

Levels	$Hg^{(199)}(p,p'\gamma)$	$E_p = 3.2$; scin
γ	**0.159** 4	B(E2) = 0.17 ($\alpha = 1.0$)
	0.209 5	B(E2) = 0.06 ($\alpha = 0.7$)

R. H. Davis, A. S. Divatia, R. D. Moffat, D. A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

Levels $Hg^{(199)}(n,n'\gamma)44^mHg^{199}$ $E_n = 0.5$ to 2

0.61
0.98
1.28
1.84

These levels feed IT state

C. P. Swann, F. R. Metzger, Phys. Rev. 100, 1329 (1955).

Resonance	$Hg^{(198)}$(n)		chopper
$\sigma_o(10^3b)$	E_o(ev)	Γ_n(mev)	Γ_γ(mev)
4.3 *10*	**23.3** *2*	5.8 *5*	145 *20*

J. S. Levin, D. J. Hughes, Phys. Rev. 101, 1328 (1956); 95, 645A (1954).

$Hg^{200}_{80\ 120}$

Level	$Hg^{200}(p,p'\gamma)$	$E_p = 4$; scin
γ	**0.368** $\tau = 59^{\mu\mu s}$	($\alpha = 0.06$)

R. Barloutaud, T. Grjebine, M. Riou, Compt. rend. 242, 1284 (1956); Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Level	$Hg^{(200)}(p,p'\gamma)$	$E_p = 3.2$; scin
γ	**0.375** *7* $\tau = 83^{\mu\mu s}$	($\alpha = 0.05$)

R. H. Davis, A. S. Divatia, R. D. Moffat, D. A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

Resonance	$Hg^{(199)}$(n)		chopper
$\sigma_o(10^3b)$	E_o(ev)	$g\Gamma_n$(mev)	Γ(mev)
8.4 *14*	**34.0** *3*	39 *3*	360 *40*

J. S. Levin, D. J. Hughes, Phys. Rev. 101, 1328 (1956).

Capture γ's	$Hg^{(199)}$(th n,γ)			sπ Cp
20†	**0.37** *1*	> 3†	**3.14** *3*	
~3†	**0.58** *2*	> 3†	**3.25** *3*	
6†	**0.68** *1.5*	> 0.5†	**3.50** *5*	
~2†	**0.83** *2*	> 0.5†	**3.60** *5*	
~7†	**0.90** *3*	> 1†	**3.80** *5*	
~3†	**1.01** *2*	> 1†	**4.12** *5*	
~2†	**1.10** *2*	3.5†	~**4.59** *5*	
> 6†	**1.22** *1.5*	6†	**4.69** *5*	
> 7†	**1.29** *1*	10†	**4.82** *3*	
	1.41 *2*	3†	**4.94** *5*	
	~**1.49** *2*	6†	**5.05** *3*	
> 4†	**1.59** *2*	1.4†	~**5.28** *5*	
	~**1.62** *2*	4.5†	**5.44** *3*	
> 13†	**1.73** *1*	6.7†	**5.67** *3*	
	1.85 *2*	2†	~**5.88** *5*	
> 6†	**2.02** *1.5*	10†	**5.99** *3*	
	2.10 *3*	2.4†	**6.31** *5*	
> 4†	**2.29** *3*	4.5†	**6.44** *3*	
	2.40 *3*	0.03†	**6.95** *5*	
> 3†	**2.64** *3*	0.03†	~**7.08** *5*	
> 1†	**2.89** *3*	0.1†	**7.66** *3*	

†Photons/100 Hg captures

Levels proposed at 0.37, 0.95, 1.10, 1.59, 1.73, 2.02, 2.10, 2.40, 2.59, 2.75, 3.00, 3.12, 3.25, 3.34, 3.44, 3.91 Level scheme implies $B_n = 8.03$ *3*

B. P. Adyasevich, B. D. Groshev, A. M. Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 270 July (1955); Consultants Bureau Trans. p. 195.

$Hg^{202}_{80\ 122}$

Level	$Hg^{202}(p,p'\gamma)$	$E_p = 4$; scin
γ	**(0.439)** $\tau = 31^{\mu\mu s}$	($\alpha = 0.03$)

R. Barloutaud, T. Grjebine, M. Riou, Compt. rend. 242, 1284 (1956); Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Level	$Hg^{(202)}(p,p'\gamma)$	$E_p = 3.2$; scin
γ	**(0.439)** $\tau = 45^{\mu\mu s}$	($\alpha = 0.03$)

R. H. Davis, A. S. Divatia, R. D. Moffat, D. A. Lind, Phys. Rev. 100, 1266A (1955); verbal report.

$_{80}Hg^{203}_{123}$ 47^{d}

β^- 100% **0.195** 2 Hg^{202}(pile n,γ); sd
$\gamma(Tl^{203})$ **0.2783** 5 $\alpha_K = 0.13$ *1* sd ce
K/LM = 2.75
No 0.473β ($<0.03\%$)

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

$\gamma(Tl^{203})$ $Hg^{(202)}$(pile n,γ) ms
(0.279) $\alpha_K = 0.159$ *4* sd ce/β
$\alpha_{L1} = 0.0247$ *3**
$\alpha_{L2} = 0.0160$ *2**
$\alpha_{L3} = 0.0084$ *2**
*Excluding systematic error of *40*

C.Nordling, K.Siegbahn, E.Sokolowski, A.H. Wapstra, Nuclear Phys. 1, 326 (1956).

$\gamma(Tl^{203})$ **(0.279)** $\alpha_K = 0.15$ *1* sl ce,cp
K/LM = 3.2

Z.O'Friel, A.H.Weber, Phys. Rev. 101, 1076 (1956).

$_{80}Hg^{204}_{124}$

Level Hg^{204}(p,p'γ) $E_p = 4$; scin
γ **0.43** *1* $\tau \sim 73^{\mu\mu}s$ ($\alpha = 0.03$)

P.Barloutaud, T.Grjebine, N.Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$_{80}Hg^{206}_{126}$

τ $<10^{h}$ or $>2^{y}$ Hg^{204}(pile n) chem
No activity observed with $\tau > 10^{h}$

R.W.Fink, G.W.Warren, B.L.Robinson, R.R. Edwards, Bull. Am. Phys. Soc. 1, No. 4, 171 E5 (1956); AECU-3165 (1956).

$_{81}Tl$?

γ Tl(γ,?γ) $E_\gamma \leq 22$; scin
0.410 *15* $\gamma\gamma$ delay = $65^{\mu s}$ *5*
0.485 *20* $\gamma\gamma$ delay = $530^{\mu s}$ *50*
$\alpha_K \sim 0.25$ x/γ
0.706 *20* $\gamma\gamma$ delay = $65^{\mu s}$ *5*

S.H.Vegors, Jr., P.Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

$_{81}Tl$

γ Tl(n,n'γ) $E_n = 0.35$ to 3.9
0.20 **0.44** scin
0.28 **0.62**
0.40 **0.70**

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956).

$_{81}Tl^{195}_{114}$ 1.2^{h}

τ **1.2**^{h} *1* Hg^{196}(20-Mev d,3n) chem
p 9.5$^{h}Hg^{195}$ chem; not p 40$^{h}Hg^{195}$ chem ($<20\%$)

J.D.Knight, E.W.Baker, Phys. Rev. 100, 1334; 99, 1646A (1955).

$_{81}Tl^{197}_{116}$ 2.8^{h} g.s.

τ **2.8**^{h} 2 Au^{197}(39-Mev α,4n) chem
$\gamma(Hg^{197})$ **0.1526** 5 sπ ce
p 65$^{h}Hg^{197}$ chem; not p 23$^{h}Hg^{197}$ ($<5\%$) chem

J.D.Knight, E.W.Baker, Phys. Rev. 100, 1334; 99, 1646A (1955).

$_{81}Tl^{198}_{117}$ 5.3^{h} g.s.

$\gamma(Hg^{198})$ Au^{197}(34-Mev α,3n) chem
0.194 sπ ce
0.2267
0.283
(0.411)
0.675
~**1.075** scin
~**1.23**
~**1.44**
Unassigned ce: 0.132, 0.512, 0.715, 0.924

J.D.Knight, E.W.Baker, Phys. Rev. 100, 1334; 99, 1646A (1955).

$_{81}Tl^{198}_{117}$ 1.9^{h}

τ **1.90**^{h} Au^{197}(37-Mev α,3n) chem
ϵ ~60% from 0.635γ/0.282γ scin
$\gamma(Hg^{198})$
10† **(0.411)** scin
~10† **(0.586)**
~13† **(0.635)**
(0.635 γ)(0.586 γ)(0.411γ) (K x ray)(~0.61γ)

P.S.Fisher, V.Knapp, Proc. Phys. Soc. 69A, 541 (1956).

$\gamma(Tl^{198})$ Au^{197}(34-Mev α,3n) chem
100* **(0.2607)** sπ ce
(0.2824)

$\gamma(Hg^{198})$		
~2*	**0.194** ?	K/LM
~3*	**0.442**	~8
~3*	**0.586**	~8
~6*	**0.635**	~6

0.635γ/0.282γ ~1.1; 0.586γ/0.282γ ~1.1 scin
Unassigned ce: 0.221, 0.292, 0.308, 0.339, 0.415 0.436, 0.458, 0.467, 0.585, 0.642, 0.753, 0.816
*Relative ce_K intensities

J.D.Knight, E.W.Baker, Phys. Rev. 100, 1334; 99, 1646A (1955).

$_{81}Tl^{202}_{121}$ 12^{d}

$\gamma(Hg^{202})$ Hg(26-Mev d) chem
70† **0.4406** *4* K/LM = 2.7 sd ce
$\alpha_K \sim 0.043$* ce_K/e_{AK}, x/γ
x 100† **K x ray** scin
$e_{AK}/(ce_K\ 0.441\gamma) = 1.92$
$[(x_L/x_K)Tl^{202}]/[(x_L/x_K)Hg^{203}] = 0.63$ *8* pc
$\therefore \epsilon_L/\epsilon_K = 0.90$ *27* if $\alpha_K/\alpha_L = 0.30$ for Hg^{203}
Used $\omega_K = 0.945$
Estimated decay energy will be revised*

P.Kramer, H.C.Hamers, G.Meijer, Physica 22, 208 (1956); *priv. comm.

$_{81}Tl^{203}_{122}$

Level — $Tl^{203}(\alpha,\alpha'\gamma)$ — $E_\alpha = 3.0$
γ **(0.279)** E2/M1 = 2.25 25 $\alpha,\gamma(\theta,\perp)$

F.K.McGowan, P.H.Stelson, Phys. Rev. 103, 1133 (1956).

Levels — $Tl^{(203)}(p,p'\gamma)$ — $E_p = 4$ scin
γ **(0.279)** $\epsilon B(E2) = 0.07$
0.680

P.Barloutaud, T.Grjebine, M.Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$_{81}Tl^{204}_{123}$ 4.1^y

τ **4.26^y** *6* — differential ic
$Tl^{(203)}$(pile n,γ) chem

J.Tobailem, J.Robert, J. phys. radium 16, 340 (1955); Ann. Phys. 10, 783 (1955).

Previous result, $\tau = 2.71^y$, retracted.
If $\tau(Tl^{204}) = 4.07^y$, decay curve has component due to unidentified nucleus with $\tau = 1.22^y$

E.E.Lockett, R.H.Thomas, Nucleonics, No. 11, 127 (1956); 11, No. 3, 14 (1953).

E_ϵ **0.376** (K x ray)(continuum γ)
From γ continuum endpoint = 0.293 *20*

R.G.Jung, M.L.Pool, Bull. Am. Phys. Soc. 1, No. 4, 172 E11 (1956).

$_{81}Tl^{205}_{124}$

γ — $Tl^{(205)}(p,p'\gamma)$ — $E_p = 4$ scin
0.205 $\epsilon B(E2) = 0.07$
~4† **0.410**
100† **0.615**

P.Barloutaud, T.Grjebine, M.Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$_{81}Tl^{208}_{127}$ 3.1^m

β^- **1.25** 1.9^y Th^{228} source; a
1.52
~22% **1.79**
~1.5% **2.38** *8*
No 5.0β (<1%) scin

F.Demichelis, R.A.Ricci, G.Trivero, Nuovo Cim. 3, 377 (1956).

$_{81}Tl^{208}_{127}$ 3.1^m

$\gamma(Pb^{208})$ **0.58332** *13* sd ce_K
$H\rho$(M) = 2891.9 *5*
Based on $H\rho$(Th C" L) = 2607.17

G.Bäckström, Arkiv Fysik 10,393 (1956).

$\gamma(Pb^{208})$ **(0.511)** E2/M1 = 0.04 $\gamma\gamma(\theta,\perp)$
(0.583) E2
(0.860) E2/M1 ~ 0.0008
(2.615) E3
(0.511 γ)(0.583 γ)($\theta,\perp$) J = $5^-, 5^-, 3^-$
(0.583 γ)(2.615 γ)($\theta,\perp$) J = $5^-, 3^-, 0^+$
(0.860 γ)(2.615 γ)($\theta,\perp$) J = $4^-, 3^-, 0^+$

G.T.Wood, P.S.Jastram, Phys. Rev. 100, 1237A (1955).

$_{81}Tl^{209}_{128}$ 2.2^m

$\gamma(Pb^{209})$ **0.120** $10^d Ac^{225}$ source; scin $\beta\gamma$
0.450
1.560
β(K x ray, 0.120γ) delay = 3.1 $^{m\mu s}$ *10*
(>1.0β)(0.450γ) delayed
$\beta(E_\gamma > 0.50)$ delayed
(0.120 γ)(0.450, 1.560γ) delay < 1.5 $^{m\mu s}$
No β to 2.01 level (<10% from γ intensities)

D.Strominger, F.S.Stephens, Jr., J.O.Rasmussen, Phys. Rev. 103, 748 (1956).

$_{81}Tl^{210}_{129}$ 1.3^m

collected from Rn^{222}
β^- **1.96** *10* scin $\beta\gamma$
$\gamma(Pb^{210})$ **0.297** *8*
0.783 *10*
2.36 *5*
(0.297 γ)(0.783, 2.36γ)

Th. Mayer-Kuckuk, Z. Naturf. 11a, 627 (1956).

$_{82}Pb$

Relative isotopic abundances ms
Pb^{204} **1.40%** 2 Pb^{207} **21.7%** *1*
Pb^{206} **25.2%** *1* Pb^{208} **51.7%** 2
No Pb^{202} (<0.003%) No Pb^{203} ($<4 \times 10^{-4}$%)
No Pb^{205} (<0.001%) No Pb^{209} ($<5 \times 10^{-5}$%)
No Pb^{210}, Pb^{211}, Pb^{212} ($<7 \times 10^{-6}$%)
No Pb^{213} ($<5 \times 10^{-6}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Resonance Pb(n) E_n = 2 to 80 kev,
peak **46** kev $l_n = 0$ Li(p,n)
Graph given showing 9 more weak peaks

H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williamson, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956).

$Pb^{202}_{82\ 120}$ 3.5^h

$(0.961\gamma)(0.422\gamma)$ delay $< 1^{m\mu s}$
$\gamma(0.961\gamma)$ delay $< 1^{m\mu s}$

G.K.Wertheim, R.V.Pound, Phys. Rev. 102, 185 (1956); priv. comm.

$Pb^{203}_{82\ 121}$ 52^h

$\gamma(Tl^{203})$ 12^hBi^{203} source
(0.279) $\alpha_K = 0.14$ xx/x

R.E.Bell, H.M.Skarsgard, Can. J. Phys. 34, 745 (1956).

$Pb^{204}_{82\ 122}$ 68^m

1.27 level Tl(22-Mev d)
μ **+0.22** 2 $\gamma\gamma(\theta,H)$
$Pb^{204}(n,n')$; 12^hBi^{204} chem
γ **0.374** E2 = 100% scin, $\gamma\gamma(\theta)$
0.890 E2 = 100%
0.905 E5 = 100%
$(0.905\gamma)(0.374, 0.890\gamma)$ delay = $0.26^{\mu s}$ 2
$(0.374\gamma)(0.890\gamma)(\theta)$ J = 4, 2, 0
$(0.905\gamma)(0.374\gamma)(\theta)$ } J = 9, 4, 2, 0
$(0.905\gamma)(0.890\gamma)(\theta)$ }

J.R.Huizenga, V.E.Krohn, S.Raboy, Phys. Rev. 102, 1063 (1956); Bull. Am. Phys. Soc. 1, No. 1, 43 K10 (1956); Phys. Rev. 95, 1354 608A (1954); 97, 1017 (1955); 98,231A (1955).

γ **0.371** M3/E2 = 0.0025 $\gamma\gamma(\theta)$
0.895 E2 = 100% scin
0.910
$(0.371\gamma)(0.895\gamma)(\theta)$ J = 4, 2, 0
Time-dependent attenuation function for $0.26^{\mu s}$ level differs from theoretical value

G.K.Wertheim, R.V.Pound, Phys. Rev. 102, 185 (1956).

$Pb^{205}_{82\ 123}$ $\sim 5 \times 10^{7y}$

$Pb^{(206)}$(21-Mev d,3n)Bi^{205} chem
τ_{ϵ_L} $\sim$**5 x 10^{7y}**
From (L x ray from Pb^{205})/(L x ray from Pb^{203}) assuming $\sigma[Pb^{206}(d,3n)] = \sigma[Pb^{204}(d,3n)]$

J.R.Huizenga, J.Wing, Phys. Rev. 102, 926 (1956).

τ_{ϵ_K} $< 2^S$ or $> 10^{10y}$ Pb^{204}(pile n,γ) chem
No Tl K x rays were observed scin

R.H.Herber, T.T.Sugihara, C.D.Coryell, W.E. Bennett, J.R.Huizenga, Phys. Rev. 103, 955 (1956).

$Pb^{206}_{82\ 124}$

Level $Pb^{(206)}(p,p'\gamma)$ $E_p = 4.6$
γ **(0.803)** $\tau = 7.5^{\mu\mu s}$ scin

P.Barloutaud, T.Grjebine, M.Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Levels $Pb^{206}(n,n')$ $E_n = 2.45$ pulsed n's

$\sigma(90°)$	Level
51 6	**0.84** 4
44 6	**1.44** 3
32 5	**1.74** 2

σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

γ $Pb^{206}(n,n'\gamma)$ $E_n = 2.56$ scin

$\sigma(95°)$	E_γ
46 8	**0.533** 5
22 7	**0.661** 10
112 12	**0.802** 8
10 5	**1.43** 3
16 7	**1.73** 3

σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

γ $Pb^{206}(n,n'\gamma)$ $E_n = 0.35$ to 3.9 scin

$\sigma(90°)$	E_γ	Thresh
30	**0.535** 5	1.38 3
17	**0.662** 5	1.475 30
50	**0.803**	0.78 3
	1.36 5	2.250 15
	1.45 5	1.55 10
10	**1.68** 3	1.75 10

σ units: mb/sterad at $E_n = 2.59$

R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56, R9 (1956); verbal report.

$Pb^{(207)}(\gamma,n\gamma)$ $E_\gamma \leq 22$; scin
$\gamma(0.343, 0.516, 0.537, 0.803, 0.880\gamma)$ delay = $132^{\mu s}$ 10
Threshold = 10.38 45

S.H.Vegors,Jr., P.Axel, Phys. Rev. 101,1067 (1956).

$Pb^{207}_{82\ 125}$ 0.82^S

τ **0.948^S** 14 Pb(pulsed n's)

N.Veeraraghavan, Proc. Indian Acad. Sci. 43A, 319 (1956).

τ **0.83^S** Pb(pulsed 14-Mev n's)

P.A.Iampol'skii, O.I.Leipunski, M.I.Gen, A.M. Tikhomirov, Izvest. Akad. Nauk. Ser. Fiz. SSSR 19, 338 (Columbia Technical Trans. p. 312) 1955.

$Pb^{207}_{82\ 125}$ Levels $Pb^{207}(n,n'\gamma)$ $E_n = 2.56$

	$\sigma(95°)$	Level	
γ	77 *14*	**0.570** *10*	scin
	51 *8*	**0.888** *10*	σ units: mb/sterad

R.B.Day, Phys. Rev. 102, 767 (1956).

Capture γ $Pb^{(206)}(th\ n,\gamma)$ $s\pi$ Cp

6.74 *3*

B.P.Adyasevich, B.D.Groshev, A.M.Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 270 July (1955); Consultants Bureau Trans. p. 195.

$Pb^{208}_{82\ 126}$ Capture γ $Pb^{(207)}(th\ n,\gamma)$ $s\pi$ Cp

7.40 *3*

No other γ (< 10% of 7.40 γ)

B.P.Adyasevich, B.D.Groshev, A.M.Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 270 July (1955); Consultants Bureau Trans. p. 195.

$Pb^{210}_{82\ 128}$ 22^{y} source chemically pure; pc

No γ with $0.025 < E_\gamma < 0.032$ (< 0.2% of 0.047γ)

Peak in this region was observed only with $Pb^{210}+Bi^{210}$ source and appears to be due to Bi^{210} bremsstrahlung.

R.W.Fink, G.W.Warren, R.R.Edwards, P.E.Damon, Phys. Rev. 103, 651 (1956).

$Pb^{212}_{82\ 130}$ 11^{h} τ **10.643**^{h} *12* source addition

J.Tobailem, J.Robert, J. phys. radium 16, 115 (1955); Ann. Phys. 10, 783 (1955).

τ **10.6**^{h} *3* differential ic

B.S.Dzhelepov, O.E.Kraft, Vestnik-Leningrad Univ., Ser. Mat. Fiz. Khim. No. 8, 97 (1955); Chem. Abstr. 50, No. 12675e (1956).

$\gamma(Bi^{212})$ **(0.238)** iron free sd ce

$H\rho(F) = 1388.45$ *10*	$E(ce_K) = 0.148083$ *18*
$H\rho(I) = 1753.91$ *14*	$E(ce_{L1}) = 0.222217$ *31*
$H\rho(I_a) = 1757.07$ *14*	$E(ce_{L2}) = 0.222897$ *31*
$H\rho(J) = 1811.11$ *15*	$E(ce_{M1}) = 0.234612$ *33*

$H\rho$ based on x ray energy data*

K.Siegbahn, K.Edvarson, Nuclear Phys. 1, 137 (1956); *Y.Cauchois, H.Hulubei, Table de Constantes et Donnees Numeriques, Herman, Paris 1947.

$Pb^{212}_{82\ 130}$ 11^{h} $\gamma(Bi^{212})$

	L_1 :	L_2 :	L_3 :	M_1 :	M_2
(0.238)	1000:	108 :	8 :	240 :	28

s ce

V.M.Kel'man, V.A.Romanov, R.Ja.Metshvapichichirli Doklady Akad. Nauk. SSSR 103, 577 (1955).

$\gamma(Bi^{212})$ **(0.238)** K/L = 5.9 4 sd ce

$L_1/L_2 = 10.0$ *7*

E.Sokolowski, K.Edvarson, K.Siegbahn, Nuclear Phys. 1, 160 (1956).

$\gamma(Bi^{212})$ **(0.238)** K/L = 5.5 2 sd ce

$(ce_K\ 0.238\gamma)/100\beta$'s = 30 ±2

O.B.Nielsen, Kgl. Danske Videnskab. Selskab Mat.-fys. Medd. 30, No. 11 (1955).

$Pb^{214}_{82\ 132}$ 27^{m} β^- 6 ±2% **1.03** *6* sl

Source chemically freed from $20^{m}Bi^{214}$

H.Daniel, Z.Naturf. 11a, 759 (1956).

$Bi^{202}_{83\ 119}$ τ **30**^{m} U(480 - Mev p) chem

A.P.Vinogradov, I.P.Alimarin, V.I. Baranov, A.K.Lavrukhina, T.V.Baranova, F.I.Pavlotskaya, A.A.Bragina, Y.V. Yakovlev, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 97 July (1955); Consultants Bureau Trans. p.65.

$Bi^{203}_{83\ 120}$ 12^{h} No γ Pb^{206}(>31-Mev p,4n) chem; scin

Observed γ's assigned to $12^{h}Bi^{204}$, $52^{h}Pb^{203}$

G.K.Wertheim, R.V.Pound, Phys. Rev. 102, 185 (1956).

$Bi^{204}_{83\ 121}$ 12^{h} τ **11.6**^{h} *2* Pb^{206}(31-Mev p,3n) chem

$\gamma(Pb^{204})$	**0.371**		sd ce, scin
	0.668	**1.20**	
	0.895	**1.73**	
	0.981	**2.10**	

(0.981 γ)(0.668, 1.20γ)

0.668, 0.981, 1.20, 1.73γ's precede 0.26$^{\mu s}$ level

0.981γ/0.910γ = 0.75 from decrease in delayed (0.9 γ)(0.9 γ) after chemical separation of Pb

G.K.Wertheim, R.V.Pound, Phys. Rev. 102, 185 (1956).

$Bi^{205}_{83\ 122}$ 14.5^{d} τ **15^{d}** U(480 - Mev p) chem

A.P.Vinogradov, I.P.Alimarin, V.I. Baranov, A.K.Lavrukhina, T.V.Baranova, F.I.Pavlotskaya, A.A.Bragina, Y.V. Yakovlev, Conf. Acad. Sci. on Peaceful Use of Atomic Energy, Chem. Sci. p. 97 July (1955); Consultants Bureau Trans. p.65. p. 65.

$Bi^{207}_{83\ 124}$ 8.0^{y} $\gamma(Pb^{207})$ **0.5697** *1* sd ce_K

$H\rho(ce_K\ 0.5697\gamma) = 2838.9$ *4*

Based on $H\rho$(Th C" L) = 2607.17

G.Bäckström, Arkiv Fysik 10, 393 (1956).

$\gamma(Pb^{207})$ **0.5697** *2* sd ce

P.Marmier, F.Boehm, quoted by D.E.Alburger, A.W.Sunyar, Phys. Rev. 99, 695 (1955).

$\gamma(Pb^{207})$ **0.56885** *30* sl pe

1.06343 *50*

No other γ with $E_\gamma = 1.06$ *8* ($< 10\%$ of 1.063γ)

A.I.Yavin, F.H.Schmidt, Phys. Rev. 100, 171 (1955).

$\gamma(0.570\gamma)$ delay = $90^{\mu\mu s}$ *30*

T.R.Gerholm, Arkiv Fysik 10, 523 (1956).

$Bi^{208?}_{83\ 125}$ γ Bi^{209}(n,2nγ) pulsed 14-Mev n's

~2.5 n,γ delay ~2.3 ms; a

Assignment from comparison of yield with that of 0.83 $^{S}Pb^{207}$ from Pb(14-Mev n,2n)

P.A.Iampol'skii, O.I.Leipunski, M.I.Gen, A.M. Tikhomirov, Izvest. Akad. Nauk. Ser. Fiz. SSSR 19, 338 (Columbia Technical Trans. p. 312) 1955.

$Bi^{209}_{83\ 126}$ $2x10^{17y}$ τ **$2x10^{17}$** *y 1*

α **3.0** *2*

12 tracks found in Bi impregnated plates stored 100 to 180 days

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956); 7a, 634 (1952).

$Bi^{209}_{83\ 126}$ Levels Bi^{209}(n,n') $E_n = 2.45$ pulsed n's

$\sigma(90°)$	Level
30	**0.93** *4*
34	**1.65** *3*

σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956).

Levels Bi^{209}(n,n'γ) $E_n = 2.56$ scin

	$\sigma(95°)$	Level	
γ	34 *4*	**0.904** *9*	
	21 *2*	**1.615** *16*	σ units: mb/sterad
		2.600 *20*	(thresh at $E_n = 2.60$)

R.B.Day, Phys. Rev. 102, 767 (1956).

Levels Bi^{209}(n,n') $E_n = 4.3$; scin pulsed n's, 90°

0.9 ?

1.8

R.V.Smith, Bull. Am. Phys. Soc. 1, No. 4, 175 F2 (1956); verbal report.

γ $Bi^{209}(\gamma,\gamma)$ $E_\gamma \leq 22$; scin

0.500 *20* $\gamma\gamma$ delay = 2.70^{ns} *25*

0.930 *30* = 2.70^{ns} *25*

S.H.Vegors,Jr., P.Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

$Bi^{210}_{83\ 127}$ 5.0^{d} τ **5.013^{d}** *5* differential ic

J.Robert, J.Tobailem, J. phys. radium 17, 440 (1956).

p $4.2^{m}Tl^{206}$ 0.00017 *2* % chem

R.W.Fink, G.W.Warren, B.L.Robinson, R.R. Edwards, Bull. Am. Phys. Soc. 1, No. 4, 171 E5 (1956).

$22^{y}Pb^{210}$ source

No γ and no L x ray pc

R.W.Fink, G.W.Warren, R.R.Edwards, P.E.Damon, Phys. Rev. 103, 651 (1956).

$e^{+}/\beta^{-} < 1.2 \times 10^{-4}$ cc

A.B.Milojević, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 21 (1956).

$Bi^{210}_{83\ 127}$ Resonances $Bi^{209}(n)$ E_n = 2 to 20000 ev chopper

E_o(kev)	Γ(ev)
0.810	5.8 *3*
2.37	17 *2*
13	double

L.M.Bollinger, D.A.Dahlberg, R.R.Palmer, G.E.Thomas, Phys. Rev. 100, 126 (1955); 95, 645A (1954).

Resonance peaks	$Bi^{209}(n)$ E_o(kev)	l_n	Li(p,n) E_o(kev)	l_n
	~1			
	~3	0	**34**	0
	13	0	**47**	0
	16		**70**	0

J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

$Bi^{212}_{83\ 129}$ 60.5^m $\gamma(Tl^{208})$ $11^h Pb^{212}$ source

113*	**(0.287)**	K/L = 5.3 sd; α(ce)
27*	**(0.327)**	
4.0*	**(0.431)**	
34*	**(0.451)**	K/L = 5
2.5*	**(0.471)**	

α(ce 0.287, 0.327, 0.431, 0.451, 0.471 γ)
*ce_K per 10^5 disintegrations

O.B. Nielsen, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 11 (1955).

$\gamma(Tl^{208})$ **(0.040)** iron free sd ce
$H\rho$(A) = 534.21 *3* $E(ce_{L_1})$ = 0.024510 *3*
$H\rho$(B) = 652.40 *4* $E(ce_{M_1})$ = 0.036153 *4*
$H\rho$ based on x ray energy data*

K.Siegbahn, K.Edvarson, Nuclear Phys. 1, 137 (1956); *Y.Cauchois, H.Hulubei, Table de Constantes et Donnees Numeriques, Herman, Paris 1947.

$\gamma(Tl^{208})$ **(0.040)** α_L = 21 *7* scin
(6.05 α)(0.040γ)(θ) J = 1^-,4^+,5^+ *
*From $\eta(\pi)$ = 0.299 *42*; E2/M1 $\leq$ 5 x 10^{-5} for 0.04γ
J(Bi^{212}) = 1^-; J(Tl^{208}) $\neq$ 6

J.W.Horton, Phys. Rev. 101, 717 (1956); 90, 388A (1953).

(6.05 α)(0.040 γ) delay > 0.1 $\mu\mu$s
No Doppler broadening observed sl $\alpha(ce_{L_1})$

J.Brude, S.G.Cohen, Phys. Rev. 101, 495 (1956).

$Bi^{214}_{83\ 131}$ 20^m

τ		**19.9^m** *4*		d $27^m Pb^{214}$ chem and	
β^-	9%	**0.42** *15*		$27^m Pb^{214}$ source;	sl
	23%	**1.02** *12*	9%	**1.88** *8*	
	40%	**1.51** *5*	19%	**3.26** *3*	

No 2.6β

H.Daniel, R.Nierhaus, Z. Naturf. 11a, 212 (1956).

β^-	~20%	~**0.45**	7%	**1.72** *9*	a
	22%	**1.03** *12*	6%	**2.57** *12*	
	29%	**1.45** *4*	13%	**3.18** *9*	

(1.45, 2.57β) γ No (3.18β) γ

R.A.Ricci, G.Trivero, Nuovo Cim. 2, 745 (1955).

Ra^{226} source scin
(E_β > 1.75)(0.61γ)(θ) J = 2^-, 2^+, 0
$\eta(\pi)$ = 0.47 *3*

F.Demichelis, L.A.Radicati, Nuovo Cim. 3, 152 (1956).

$\gamma(Po^{214})$ Ra^{226} source sπ Cp

464†	**(0.6093)**	43†	**(1.5093)**
38†	**0.6524***	21†	**1.5829***
	0.6609*	7†	**1.6052***
19†	**0.7032***	29†	**(1.7283)**
70†	**(0.7687)**	252†	**(1.7644)**
17†	**0.7871***	44†	**1.7838***
17†	**0.8063***	14†	**1.7907***
13†	**0.8213***	28†	**(1.8485)**
52†	**(0.9348)**	22†	**1.8623***
206†	**(1.1204)**	19†	**1.900**
40†	**(1.1553)**	6†	**(2.0167)**
19†	**1.2071***	9†	**2.085**
88†	**(1.2383)**	23†	**(2.1170)**
26†	**(1.2813)**	100†	**(2.2042)**
72†	**(1.3782)**	7†	**2.290**
73†	**1.3853***	4†	**2.340**
	1.3911*	41†	**(2.432)**
	1.3965*		
	1.4017*		
	1.4080*		
	1.4380*		

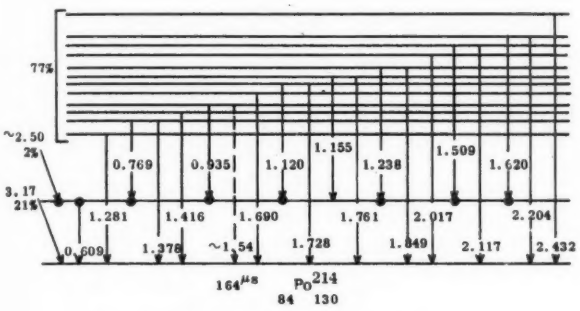
No 1.4159 photon (<3%)
*Energies assigned assuming ce_K's were observed by Mladjenović and Slätis. Assignment accounts for spectrum between peaks

B.S.Dželepov, S.A.Šestopalova, Nuovo Cim. 3, Suppl. No. 1, 54 (1956).

$Bi^{214}_{83\ 131}$ 20^m

Coincident radiation	E_γ = 0.609	0.769	0.935	1.120	1.238	1.378	1.509	1.620	1.764	2.200
0.609γ		Y	Y	Y	Y	Y	Y	Y		
E_β = 0.65		Y	Y	Y	Y	Y	Y	N	Y	N
$0.9 < E_\beta < 1.5$		Y	Y	Y	Y	Y	Y		Y	
$1.5 < E_\beta < 1.7$		Y	Y	Y		Y	Y			
$1.7 < E_\beta < 1.9$		Y	Y			Y				
$1.9 < E_\beta < 2.5$		Y								

Intensity of $2.5\beta^-$ ~10% of $3.17\beta^-$
Y = coincidence observed scin
N = coincidence not observed



S.E.Johansson, Arkiv Fysik 9, 561 (1955).

$Po^{203}_{84\ 119}$ 42^m

τ 42^m Bi^209(60-Mev p,7n)

R.E.Bell, H.M.Skarsgard, Can. J. Phys. 34, 745 (1956).

$Po^{205}_{84\ 121}$ 1.8^h

τ 1.8^h 1 Bi^209(40-Mev p,5n)

R.E.Bell, H.M.Skarsgard, Can J. Phys. 34, 745 (1956).

$Po^{206}_{84\ 122}$ 9^d

ε/α = 95/5 (Rn^210 α)/(Po^206 α) ic

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955).

$Po^{208}_{84\ 124}$ 2.9^y

γ(Bi^208) Bi^209(d,3n) chem

3^+	0.285		scin
6^+	~0.60	double	

(K x ray) (0.285, ~0.60 γ)
(0.285 γ) (both 0.60 γ's)
Source ~99% Po^208 from (Po^208 α)/Po^209 α)
†Photons per 10^5 α's

I. Perlman, F. Asaro, F.S. Stephens, J.P. Hummel, R.C. Pilger, UCRL-2932, p 59 (1955); priv. comm.

$Po^{208,9}_{84}$

γ(?)	~70†	0.270	Bi^209(20-Mev p)
	~70†	0.570	scin
	75†	0.865	

(0.270 γ)(0.570 γ)
0.865γ is not crossover Σ scin
Source 14.5% Po^209 (band spectrum measurement)
†Photons per 10^4 α's

E.H.Daggett, G.R.Grove, Phys. Rev. 99, 1 (1955); 95, 627A (1954).

$Po^{209}_{84\ 125}$ J

ground state 1/2 S

K.L.Vander Sluis, P.M.Griffin, J. Opt. Soc. Am. 45, 1087 (1955).

$Po^{209}_{84\ 125}$ 103^y

τ 103^y 4
From sample with Po^{209}/Po^{208} = 0.176 2, $(Po^{209}\ \alpha)/(Po^{208}\ \alpha)$ = 0.0050 2, and τ(Po^208) = 2.93^y 3

C.G.Andre, J.R.Huizenga, J.F.Mech, W.J. Ramler, E.G.Rauh, S.R.Rocklin, Phys. Rev. 101, 645 (1956).

γ(Pb^205) Bi^209(d,2n) chem

40†	0.260	α_K = 0.75	scin

γ(Bi^209)

50†	0.910	α_K = 0.021	

α(0.260 γ) (K x ray)(0.910 γ)
ϵ_{LM}/ϵ_K ~0.2
All ε to 0.910 level of Bi^209 xγ/x
Source 85% Po^209 from $(Po^{209}\alpha)/(Po^{208}\ \alpha)$
†Photons per 10^4 α's

I.Perlman, F.Asaro, F.S.Stephens, J.P.Hummel, R.C.Pilger, UCRL-2932, p 59 (1955); priv. comm.

$Po^{217}_{84\ 133}$ $<10^s$

τ		$<10^s$	$25^m Rn^{221}$ recoil
β^-	<20%	$(Fr^{221}\ \alpha)/(At^{217}\ \alpha)$ = 1.00 5	ic
α		6.54 2	

F.F.Momyer,Jr., E.K.Hyde, Phys. Rev. 101, 136 (1956).

$At^{211}_{85\ 126}$ 7.2^h

Bi^209(29-Mev α,2n) chem

τ		7.20^h 5		ic α
γ	4†	0.06235 50		cryst
x	100†	K x ray		cryst
ce		0.0460 3 ?		s77 ce

P.R.Gray, Phys. Rev. 101, 1306 (1956).

Rn^{208} 86 122 23^m

τ		23^m 2	Th^{232}(340-Mev p)	chem
ϵ	~80%		$(Po^{208}\ \alpha)/(Rn^{208}\ \alpha)$	ic
α	~20%	6.14 2		ic

p $3.8^h Po^{204}$ (5.37α observed)

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955).

α	6.141 4	s

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955).

Rn^{209} 86 123 30^m

τ		30^m 2	Th^{232}(340-Mev p)	chem
ϵ	83%		$(At^{209}\ \alpha^*)/(Rn^{209}\ \alpha)$	ic
α	17%	6.02 2		ic

p $5.5^h At^{209}$ (5.65α observed)
*Used $\epsilon(At^{209})/\alpha(At^{209}) = 95/5$

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1,274 (1955); Phys. Rev. 86, 805 (1952).

α	6.037 10	s

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955).

Rn^{210} 86 124 2.7^h

τ		2.7^h 2	Th^{232}(340-Mev p)	chem
ϵ	~4%		$(Po^{210}\ \alpha)/(Rn^{210}\ \alpha)$	ic
α	~96%	6.02 2		ic

p $9^d Po^{206}$ (5.22α observed)

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955); Phys. Rev. 86, 805 (1952).

α	6.037 3	s

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955).

Rn^{211} 86 125 16^h

τ		16^h 1	Th^{232}(340-Mev p)	chem
ϵ	74%		$(Po^{211}\alpha)/(Rn^{211}\alpha + At^{211}\alpha^\$)$	ic
$\gamma(At^{211})$*		0.030		scin
		0.240	0.97	
		0.430	1.13	
		0.890	1.34	
α	26%	5.82 2		ic

p $7.2^h At^{211}$ chem
$Used $\epsilon(At^{211})/\alpha(At^{211}) = 60/40$

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955); Phys. Rev. 86, 805 (1952); *B.Raby, A.W.Stoner, ibid.

Rn^{211} 86 125 16^h

α	2.0†	5.613 7	Th^{232}(340-Mev p)	chem;s
	64.5†	5.779 3		
	32.5†	5.847 2		
$\gamma(Po^{207})$		0.0688$^\$$		s π ce
		0.169*		scin $\alpha\gamma$
		0.234*		scin $\alpha\gamma$

$\alpha(0.069, 0.169, 0.234\gamma)$*

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955); *A.W.Stoner, F. Asaro, ibid.; $A.W.Stoner, W.G.Smith, J.M. Hollander, ibid.

Rn^{212} 86 126 23^m

α	6.262 5	s

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955).

Rn^{220} 86 134 52^s

τ	51.5^s 10	d	Th^{232} chem

H.Schmied, R.W.Fink, B.L.Robinson, J. Inorg. Nucl. Chem. 1, 342 (1955).

Rn^{220} 86 134 52^s

$\gamma(Po^{216})$		Rn collected from Th^{228}	
~2.5†	0.542 2		scin

Not emitted in decay of $0.16^s Po^{216}$ (intensity changed <10% by reversal of electric field)
†Photons per 10^4 disintegrations

L.Madansky, F.Rasetti, Phys. Rev. 102, 464 (1956).

Rn^{221} 86 135 25^m

τ	25^m 2	Th^{232}(110-Mev p)	chem
$\beta/\alpha = 4 \pm 1$		$(At^{217}\alpha)/(Po^{217}\alpha)$	ic

p At^{217} and Po^{213} (7.02α, 8.34α observed)

F.F.Momyer,Jr., E.K.Hyde, Phys. Rev. 101, 136 (1956).

Rn^{222} 86 136 3.8^d

τ	3.8229^d 27	differential ic

P.C.Marin, Brit. J. Appl. Phys. 7, 188 (1956).

τ	3.825^d 5	differential ic

J.Tobaillem, Compt. rend. 233, 1360 (1951); Ann. Phys. 10, 783 (1955).

τ	3.825^d 4	calorimeter

J.Robert, J. phys. radium 17, 605 (1956).

$Rn^{222}_{86\ 136}$ 3.8^{d}

$\gamma(Po^{218})$ Rn collected from Ra^{226}
~7† **0.510*** 2 scin
Intensity remained constant for first 2 min after collection, ∴ not in decay of $3^{m}Po^{218}$
*No (0.51 γ)(0.51 γ), hence not $\gamma^{\pm}$
†Photons per 10^{4} disintegrations

L.Madansky, F.Rasetti, Phys. Rev. 102, 464 (1956).

$Fr^{211}_{87\ 124}$

τ Not 2^{m} to 5^{m}* Th^{232}(340-Mev p) chem
No Rn daughter observed

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955); *Phys. Rev. 86, 805 (1952).

$Fr^{212}_{87\ 125}$ 19^{m}

Th^{232}(340-Mev p) chem

α	24†	**6.342** 7	s
	39†	**6.387** 9	
	37†	**6.411** 9	

F.F.Momyer, Jr., F.Asaro, E.K.Hyde, J. Inorg. Nucl. Chem. 1, 267 (1955).

$Fr^{221}_{87\ 134}$ 4.8^{m}

$\alpha(0.22\gamma)$ delay $< 1^{m}\mu s$ $10^{d}Ac^{225}$ source; scin

D.Strominger, F.S.Stephens, Jr., J.O. Rasmussen, Phys. Rev. 103, 748 (1956).

$Fr^{223}_{87\ 136}$ 22^{m}

d $22^{y}Ac^{227}$ chem
τ **22**^{m} 1 from growth of $12^{d}Ra^{223}$ ppl
α 0.006% **5.34** 8 ppl
p Ra^{223} (τ, α and β spectra identified)

M.Perey, M.J.Adloff, J. phys. radium 17, 545 (1956); compt. rend. 240, 1421 (1955).

$Ra^{213}_{88\ 125}$ 2.7^{m}

τ		**2.7**^{m} 3	Th^{232}(340-Mev p) chem
α		**6.90** 4	ic

p $30^{m}Rn^{209}$ (6.02 α observed)

F.F.Momyer, Jr., E.K.Hyde, J. Inorg. Nucl. Chem. 1, 274 (1955).

$Ra^{225}_{88\ 137}$ 15^{d}

$\alpha/\beta^{-} < 0.01\%$ Th^{229} chem
No $25^{m}Rn^{221}$ observed ic

F.F.Momyer,Jr., E.K.Hyde, Phys. Rev. 101, 136 (1956).

$\beta(0.040\gamma)$ delay $< 4^{m}\mu s$

D.Strominger, J.O.Rasmussen, Phys. Rev. 100, 844 (1955).

$Ra^{226}_{88\ 138}$ 1620^{y}

(ce 0.186γ)/α = 0.028 5 ppl
(4.61α)(ce 0.186γ)(θ) J = 0, 2, 0

G.Albouy, Ann. Phys. 1, 99 (1956).

$Ac^{226}_{89\ 137}$ 29^{h}

$\gamma(Th^{226})$ **0.159** scin
0.232

F.S.Stephens,Jr., F.Asaro, I.Perlman, Phys. Rev. 100, 1543 (1955); J.R.Grover, G.T. Seaborg, ibid.

$Ac^{227}_{89\ 138}$ 22^{y}

β^{-} **0.0455** 10 pc
F-K linear ($E_{\beta} > 0.007$)
No 0.037 γ, no ce, no Th L x ray 4π pc
0.0167 5 and 0.020 1 γ's observed but growth suggests assignment to impurity

W.Beckmann, Z. Phys. 142, 585 (1955). Z.Naturf. 10a 86 (1955).

$Th^{227}_{90\ 137}$ 18^{d}

$\alpha(0.050\gamma)$ delay $< 2^{m}\mu s$ scin

R.Foucher, L.Dick, N.Perrin, H.Vartapetian, J. phys. radium 17, 581 (1956).

$Th^{228}_{90\ 138}$ 1.9^{y}

τ **1.910**^{y} 2 Ra^{226}(pile n) chem

H.W.Kirby, G.R.Grove, D.L.Timma, Phys. Rev. 102, 1140 (1956).

$\gamma(Ra^{224})$ **0.084** ppl α(ce)
ce/α = 0.25 2

G.Albouy, Ann. Phys. 1, 99 (1956).

$Th^{230}_{90\ 140}$ 8.0×10^{4y}

$\gamma(Ra^{226})$ 9% Th^{230}

59†	**0.068**	scin
7†	**0.142**	
1.4†	**0.184**	E1
1.7†	**0.253**	E1

E1 assignments from systematics
†Photons per $10^{4}\alpha$'s

F.S.Stephens,Jr., F.Asaro, I.Perlman, Phys. Rev. 100, 1543 (1955).

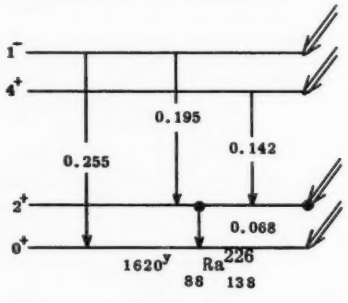
$\gamma(Ra^{226})$ **0.068** ppl α(ce)
ce/α = 0.23 2

G.Albouy, Ann. Phys. 1, 99 (1956).

Th^{230} 90 140 8.0×10^{4y} $\gamma(Ra^{226})$ 10% Th^{230} scin

	64 *8*†	**0.068** *1*	$\alpha = 46$ *5*
	8 *1*†	**0.142** *2*	
	0.5 *2*†	**0.195** *5*	
	0.3 *1*†	**0.255** *3*	
x	4 *1*†	**K x ray**	
	1100 *150*†	**L x ray**	

α(0.068γ, L x ray) delay $< 10^{-9}$s
(L x ray)(0.142, 0.195, 0.255γ; not 0.068γ)
$\omega_L = 0.52$ *5* from (L x ray)(0.142γ)/(0.142γ)
using $\alpha_L/(1+\alpha) = 0.73$ for the 0.068γ
†Photons per 10^4 disintegrations

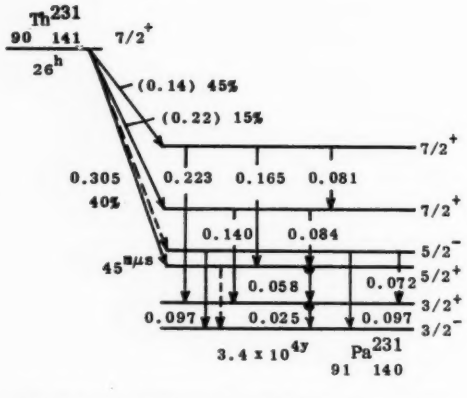


E.Booth, L.Mandansky, F.Rasetti, Phys. Rev. 102, 800 (1956).

Th^{231} 90 141 26^h β^- **0.305** *10*

$\gamma(Pa^{231})$	**0.0255**	sπ ce, pc,
	0.0585	**0.0974** scin
	0.0719	**0.140**
	0.0812	**0.1632**
	0.0841	**0.223**

(0.305β)(~ 0.08γ) delay = $45^{m\mu s}$ *3*
(~0.08 γ)(0.0255, 0.0585 γ)



J.P.Mize, J.W.Starner, Bull. Am. Phys. Soc. 1, No. 4, 171 E6 (1956); verbal report.

β(0.026, 0.085 γ) delay = $41^{m\mu s}$ *4*

D.Strominger, J.O.Rasmussen, Phys. Rev. 100, 844 (1955).

Th^{232} 90 142 1.4×10^{10y} τ **1.45×10^{10}y** *5* Specific activity

R.L.Macklin, H.S.Pomerance, J. Nuclear Energy 2, 243 (1956).

τ for spontaneous fission $> 10^{20}$y ic
From 0.002 fissions per hr gm of sample.
However half of these counts are due to presence of 0.006% U

A.V.Podgurskaya, V.I.Kalashnikova, G.A. Stolyarov, E.D.Vorob'ev, G.N.Flerov, Zhur. Eksptl' i Teoret. Fiz. 28, 503 (1955); AERE Lib/Trans. 569.

τ for spontaneous fission = 1.4×10^{18}y
From 0.15 fissions per hr gm of sample.
Less than 0.1 of these counts are due to U

E.Segrè, Phys. Rev. 86, 21 (1952).

$\gamma(Ra^{228})$ **0.059** *1* L/M~3 ppl α(ce)
ce/α = 0.24 *3*

S.W.Peat, M.A.S.Ross, Proc. Phys. Soc. 68A, 923 (1955).

$\gamma(Ra^{228})$ **0.060** ppl α(ce)
ce/α = 0.22 *2*

G.Albouy, Ann. Phys. 1, 99 (1956).

Th^{232} 90 142 Level $Th^{232}(\alpha, \alpha'\gamma)$ $E_\alpha = 3.3$; scin
γ **0.050** *5* $\tau = 780^{\mu\mu s}$ (α = 340)

A.S.Divatia, R.H.Davis, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

γ $Th^{232}(p, p'\gamma)$ $E_p = 4.8$

1.1*	**0.719**	K/L = 3.5	sπ ce

*$\sigma(90°)$ for ce_K in μb/sterad

M.S.Moore, C.M.Class, F.W.Prosser, Jr., J.P. Schiffer, Bull. Am. Phys. Soc. 1, No. 2, 88, H2 (1956).

Th^{233} 90 143 22^m τ **22.12^m** *5* Th^{232}(pile n, γ) chem

E.N.Jenkins, Analyst 80, 301 (1955).

Th^{233} 90 143

Resonances $Th^{232}(n)$ chopper

E_o(ev)	Γ_γ(mev)
(22.1, 23.8)	30 *10* for each

Used $\sigma_o\Gamma^2 = 7 \pm 2, 13 \pm 4$ for 22.1, 23.8 resonances respectively

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Resonances $Th^{232}(n)$ chopper

E_o(ev)	Γ_n(mev)	Γ_γ(mev)
22.0 *2*	1.24 *36*	28 *11*
23.6 *2*	3.35 *77*	25 *8*

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
60 *1*	6.8 *19*	210 *4.5*	1.8 *14*
70.7 *9*	44 *13*	225 *5*	16 *9*
115 *2*	15 *5*	235 *5.4*	14 *8*
125 *2*	25 *10*	260 *6*	45 *3*
135 *2.3*	15 *6*	270 *6.5*	60 *1:*
175 *3.4*	36 *10*	295 *7.5*	12 *7*
195 *4*	22 *7*	350 *9*	205 *50*

*Assuming Γ_γ = 25 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Th^{234} 90 144 24^d

$\alpha/\beta < 10^{-6}$ ppl

S.Deutsch, M.Nikolic, Nuovo Cim. 2, 1326 (1955).

β^- 35% **0.100** *2* sπ $\beta\gamma$
65% **(0.191)**
(0.100 β)(0.090 γ)

E.F.deHaan, G.J.Sizoo, P.Kramer, Physica 21, 803 (1955); 19, 1201 (1953).

$\gamma(Pa^{234})$ **(0.029)** α_L = 11 scin
β(0.063, 0.091γ) delay = 1.8$^{m\mu s}$ *3*
α_L from ω_L = 0.46 and measured ratio
(0.063 γ)(L x ray)/(0.063 γ)(0.029γ)

H.Vartapetian, L.Dick, R.Foucher, N.Perrin, J. phys. radium 17, 537; Compt. rend. 242, (1956).

$\gamma(Pa^{234})$ 5% **0.0290** d U^{238} chem
5% **0.0628** α_L = 0.45
16% **0.0914** α_{L1} = 2.0 L/MN = 3.1
(~0.08β)(ce$_K$ 0.0914 γ)
No 0.0471γ (ce's reinterpreted)
No 0.100γ (assigned to 6.7^hPa^{234})
No 0.043γ (assigned to 1.2^m and 6.7^hPa^{234})

Ong Ping Hok, J.T.Verschoor, P.Born, Physica 22, 465 (1956).

Pa^{231} 91 140 3.4×10^4y

α	1.3%	**4.6710** *50*		sd
	0.8%	**4.7040** *80*	?	
	10%	**4.7270** *50*		
	1.5%	**4.8476** *50*		
	24%	**4.9420** *70*		
	1.5%	**4.9740** *60*		
	26%	**5.0060** *70*		
	23%	**5.0205** *45*		
	12%	**5.0490** *30*		

No α with $4.7270 \le E_\alpha \le 4.8476$ (< 0.1%)

L.L.Gol'din, E.F.Tret'yakov, G.I.Novikova, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL Trans. 242.

$\gamma(Ac^{227})$ **(0.027)**
0.290 α_K~0.05 E1 $x_K\gamma/\gamma\gamma$
(α, 0.290 γ)(0.027 γ) delay = 37$^{m\mu s}$

R.Foucher, L.Dick, N.Perrin, H.Vartapetian, J. phys. radium 17, 581 (1956).

Interpretation of α(ce)(ce) coincidences ppl	Number per 10^3 α's
α(0.011 γ)(0.027 γ)	30 to 50
α(0.064 γ)(0.038 or 0.027 γ)	40 to 70
α(0.096 γ)(0.102 γ)	0.3 to 6
α(0.096 γ)(0.064 γ)	0.6 to 0.9
α(0.064 γ)(0.011 γ)(0.027 γ)	15 to 20
α(0.096 γ)(0.064 γ)(0.038 or 0.027 γ)	3 to 4
α(0.096 γ)(0.064 γ)(0.011 γ)(0.027 γ)	0.6 to 1

Results agree with decay scheme of Falk-Vairant but not with that of Gol'din, et al. or Hummel, et al.

G.Albouy, Ann. Phys. 1, 99 (1956).

Pa^{234} 91 143 6.7^h g.s.

β^- 28%* **0.155** d $24^d$$Th^{234}$ chem; sd
32% **0.32** *2*
27% **0.53** *2*
13% **1.13** *5*

$\gamma(U^{234})$

		ce's per 1000 β's			
		K	L_1	L_2	L_3	M	
20%	**0.0430**			65	60	51	scin,
14%	**0.0992**			59	44	28	sd ce
15%	**0.125**						
7%	**0.153**			15	7	5.5	
13%	**0.225**	44	7.5			2	
	0.293						
	0.333						
3.5%	**0.368**	6	1.7				
7%	**0.566**	6	1.7				
	0.603						
9%	**0.732**	1.2	0.7				
0.2%	**0.803**	1.2	0.5				
14%	**0.877**	1.5	1.1			0.9	
25%	**0.924**	1.1					

Continued

Pa^{234} 91 143 6.7^h g.s.

Continued

$\gamma(U^{234})$ 1.24

3.5% 1.43 *3*

2.5% 1.68 *3*

*Uncertain (10% from γ intensities)

Ong Ping Hok, J.T.Verschoor, P.Born, Physica 22, 465 (1956); 19, 1205 (1953); Phys. Rev. 99, 1613 (1955).

Pa^{234} 91 143 1.2^m

τ 1.25^m *10* d $24^d Th^{234}$ chem, $24^d Th^{234}$ source

$\gamma(U^{234})$

2.5%	0.0430			sd ce,scin
	0.230	1.5%	1.01	
0.10%	0.255		1.24	
0.87%	0.770	0.09%	1.44	
0.16%	0.803	0.07%	1.69	
	0.807	0.11%	1.83	

$1.2^m Pa^{234}$ level 0.060 *15* above $6.7^h Pa^{234}$ from tentative decay scheme

Ong Ping Hok, J.T.Verschoor, P.Born, Physica 22, 465 (1956).

β^- 0.60 Th^{234} source; $s\pi\ \beta\gamma$

1.50

$\gamma(U^{234})$ (0.80) $\alpha_K = 0.15^*$ M2

*Assuming proposed decay scheme

E.F.deHaan, G.J.Sizoo, P.Kramer, Physica 21, 803 (1955).

U 92 Relative isotopic abundances ms

U^{234}	0.0056% *1*
U^{235}	0.718% *5*
U^{238}	99.276% *5*

No U^{232}, U^{233} ($< 6 \times 10^{-5}$%)
No U^{236} ($< 2 \times 10^{-4}$%)
No U^{237}, U^{239} ($< 1 \times 10^{-4}$%)
No U^{240} ($< 5 \times 10^{-5}$%)

F.M.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Relative isotopic abundances ms

U^{234}	0.0057%* 2
U^{235}	0.7204% *7*
U^{238}	99.2739% *7*

*Assumed value

M.Lounsbury, Can. J. Chem. 34, 259 (1956).

U 92 Level $U(n,n')$ E_n = 0.5 to 1.0

0.70 sphere, He^3 pc

R.Batchelor, Proc. Phys. Soc. 69A, 214 (1956).

U^{233} 92 141

ground state

J 5/2 S

$\mu(U^{233})/\mu(U^{235}) = -1.8$ *1* Used $J(U^{235}) = 5/2$

$q(U^{233})/q(U^{235}) = +2.0$ *3*

N.I.Kaliteevskii, M.P.Chaika, Doklady Akad. Nauk SSSR 103, 49 (1955).

ground state

J 5/2 S

$\mu(U^{233})/\mu(U^{235}) \sim -1.5^*$

*From comparison with published data on same line in U^{235} spectrum. Used $J(U^{235}) = 5/2$

L.A.Korostyleva, A.R.Striganov, N.M.Iashin, Zhur. Eksptl' i Teoret. Fiz. 28, 471 (1955); Soviet Phys. JETP 1, 310 (1955); Izvest. Akad. Nauk. Ser. Fiz. SSSR 19, 31 (1955).

U^{233} 92 141 $1.6 \times 10^5 y$

α	0.03%	4.489 *5*	1.6%	4.7174 *10*	sd
	0.04%	4.582	14.9%	4.7732 *4*	
	0.07%	4.655	83.5%	4.8157 *5*	

L.L.Goldin, G.I.Novikova, E.F.Tretyakov, Phys. Rev. 103, 1004 (1956); Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL-Trans. 242.

α's emitted preferentially in the direction perpendicular to nuclear axis $\alpha(\theta,T)$

$W(\theta) = 1 - 0.06P_2(\cos\theta)$ at 1.1°K

J.W.T.Dabbs, L.D.Roberts, G.W.Parker, Bull. Am. Phys. Soc. 1, No. 4, 207 R9 (1956).

Th^{232}(pile n) chem

$\gamma(Th^{229})$ ~0.040 L/MN = 3 ±1 ppl

~0.09

(ce 0.054 γ)(ce 0.040γ)/α = 0.003 *1*

G.Albouy, Ann. Phys. 1, 99 (1956).

U^{234} 92 142 $2.5 \times 10^5 y$

α	28%	4.7168 *10*	sd
	72%	4.7683 *10*	

L.L.Gol'din, E.F.Tret'yakov, G.I.Novikova, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL Trans. 242.

U^{234} 92 142

Resonances $U^{233}(n)$ cryst

σ_{to}	E_o(ev)	Γ(mev)	Γ_f(mev)
975	**1.785**	300	270
1020	**2.290**	100	70
233	**3.635**	198	168
1015	**6.795**	187	157
680	**10.375**	294	264

V.L.Sailor, Phys. Rev. 100, 1249A (1955); verbal report.

Resonances $U^{233}(n,f)$ $E_n = 10^{-3}$ to 10^3 ev cryst

1.80 2 ev **5.1**
2.30 2 **7**
3.5 **12**

J.M.Auclair, M.Galula, P.Hubert, B.Jacrot, R.Joly, F.Netter, G.Vendryes, Geneva Conf. 8/P/354 (1955).

U^{234} 92 142 2.4×10^{5}y

Resonances $U^{233}(n,f)$ $E_n = 0.035$ to 5.3 ev

1.80 2 ev $\Gamma = 0.36$ ev cryst
2.30 2 $\Gamma = 0.17$
3.6
4.7

L.G.Miller, J.E.Evans, Bull. Am. Phys. Soc. 1, No. 5, 247 C5 (1956).

U^{235} 92 143

ground state

J **7/2** para
$|\mu|$ **0.38 or 0.31**

C.A.Hutchison, Jr., P.M.Llewellyn, E.Wong, P.Dorain, Phys. Rev. 102, 292 (1956).

ground state S

J **5/2 (7/2?)**
$\mu(U^{233})/\mu(U^{235}) = -1.8$ *1*
$q(U^{233})/q(U^{235}) = +2.0$ *3*

N.I.Kaliteevskii, M.P.Chaika, Dokoady Akad. Nauk SSSR 103, 49 (1955).

U^{235} 92 143 7.1×10^{8}y

$(4.40\,\alpha)(0.188\,\gamma)$ scin

P.Huber, K.P.Meyer, E.Würger, Helv. Phys. Acta 28, 326A (1955).

$\gamma(Th^{231})$ enriched U^{235} scin

~13†	**0.146** *3*	
55†	**0.188** 2	
3.7†	**0.209** *4* ?	
0.03†	**0.349** *4* ?	

No other γ with $0.26 < E_\gamma < 0.45$ (< 0.01†)
†Photons per 100 α's

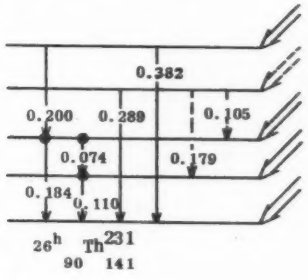
C.W.Malich, Bull. Am. Phys. Soc. 1, No. 1, 43 K12 (1956).

U^{235} 92 143 7.1×10^{8}y

$\gamma(Th^{231})$

0.074	**0.200** scin $\gamma\gamma$
0.110	**0.289**
0.184	**0.382**

(~0.075 γ)(0.110, 0.200γ)
(~0.105 γ)(0.074, 0.200γ)
(~0.180 γ)(K x ray, 0.200γ)
(~0.195 γ)(K x ray, 0.184γ)
No (> 0.200γ)γ
Gating channel width ~20 kev



S.A.E.Johansson, Arkiv Fysik 10, 97 (1956).

U^{236} 92 144

Resonances $U^{235}(n)$ chopper

E_o(ev)	$2g\Gamma_n$(mev)$^\$$	E_o(ev)	$2g\Gamma_n$(mev)$^\$$
9.25 *5*	0.16 *5*		
9.70 *5*	0.069 *16*	**25.9** *4*	0.39 *13*
10.13 *5*	0.054 *16*	**26.8** *4*	0.83 *21*
10.6?		**28.0** *4*	0.69 *11*
11.6 *1*	0.58 *5*	**28.6** *4*	0.35 *11*
12.4 *1*	1.40 *9*	**29.9** *5*	0.26 *11*
12.8 *1*	0.050 *18*	**31.1** *5*	1.11 *17*
13.3 *1*	0.110 *18*	**32.3** *5*	2.3 *6*
13.8?		**33.8** *5*	2.0 *4*
14.1 *1*	0.34 *4*	**34.7** *6*	2.6 *5*
14.7 *1*	0.122 *19*	**35.3** *6*	5.3 *9*
15.5 *1*	0.213 *20*	**38.4** *7*	0.16 *4*
16.2 *1*	0.350 *20*	**39.7** *7*	2.5 *6*
16.8 *2*	0.226 *20*	**42.0** *7*	2.2 *6*
17.5?		**43.7** *8*	1.0 *3*
18.2 *2*	0.338 *13*	**44.8** *8*	1.8 *5*
19.5 *2*	2.78 *18*	**47.1** *8*	1.2 *3*
20.3?		**48.6** *9*	5.2 *11*
21.2 *2*	1.29 *28*	**51.6** *9*	46 *11*
23.2 *3*	0.63 *10*	**55.4** *10*	2.9 *6*
23.7 *3*	1.51 *10*	**56.4** *10*	8.6 *19*
24.5 *3*	0.64 *10*	**58.3** *10*	3.8 *8*
25.6 *3*	0.61 *15*	**61.0** *11*	1.2 *6*

$U^{235}(n,f)$

E_o(ev)	Γ_f(mev)$^\$$	E_o(ev)	Γ_f(mev)$^\$$
11.6 *1*	9 *11*		
12.4 *1*	16 *12*	**23.7** *3*	105 *81*
16.2 *1*	12 *17*	**34.7** *6*	48 *27*
19.5 *2*	79 *22*	**35.3** *6*	82 *33*

$^\$$Used $\overline{\Gamma}_\gamma = 30$ mev.

O.D.Simpson, R.G.Fluharty, F.B.Simpson, Phys. Rev. 103, 971 (1956); 100, 1249A (1955).

U^{236} 92 144

Resonances $U^{235}(n,f)$ $E_n = 0.005$ to 150 ev cryst, chopper

E_o(ev)	Peak σ_f*
−0.01 to 0.01	
1.12	85
3.55	98
6.3	130
7.0	89
8.7	840
12.2	450
19.5	640
33.5	960

*Assuming Γ = 0.15 ev

B.T.Price, J.Nuclear Energy 2, 128 (1955).

Resonances $U^{235}(n,f)$ $E_n = 10^{-3}$ to 200 ev cryst

0.29 ev	6.8	
1.1	9	
3.4	14	

J.M.Auclair, M.Galula, P.Hubert, B.Jacrot, R.Joly, F.Netter, G.Vendryes, Geneva Conf. 8/P/354 (1955).

Resonances $U^{(235)}(n,f)$ pulsed n's

σ_{fo}*	E_o(ev)	$\sigma_f\Gamma$	Γ_γ/Γ_f
1278	8.8	110	0.5
100	11.7	7.4	6
624	12.34	43.7	2
1479	19.3	103.5	1

*From $\sigma_f\Gamma/\sigma_t\Gamma$ and σ_{to}

M.L.Yeater, W.R.Mills, D.E.McMillan, E.R. Gaerttner, Bull. Am. Phys. Soc. 1, No. 1, 8, A5 (1956); verbal report.

U^{237} 92 145 6.75^d

β^-	26%	0.084	$U^{236}(n,\gamma)$ chem; sd
	74%	0.249	
$\gamma(Np^{237})$		0.026	0.165 sd ce
		0.033	0.193 ?
		0.043	0.208
		0.060	0.268
		0.069 ?	0.330
		0.101	0.370
		0.124 ?	0.433

S.A.Baranov, K.N.Shlyagin, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 251 July (1955); Consultants Bureau Trans. p. 183.

U^{238} 92 146 4.5x10^{9y}

$\gamma(Th^{234})$ 0.048 ppl α(ce)

ce/α = 0.23 2

G.Albouy, Ann. Phys. 1, 99 (1956); G.Albouy, J.Teillac, Compt. rend. 234, 829 (1952).

U^{238} 92 146

Level $U^{(238)}(\alpha,\alpha'\gamma)$ E_α = 3.3; scin

γ 0.045 3 $\tau = 440^{\mu\mu 48}$ (α = 700)

A.S.Divatia, R.H.Davis, R.D.Moffat, D.A.Lind, Phys. Rev. 100, 1266A (1955); verbal report.

U^{238} 92 146

Levels $U^{238}(n,n')$ E_n = 2.45 pulsed n's double

σ(90°)	Level
10 3	1.18 3

σ units: mb/sterad

L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956); Bull. Am. Phys. Soc. 1, No. 1, 56 R10 (1956).

U^{239} 92 147

Resonances $U^{(238)}(n)$ chopper

$\sigma_o(10^3 b)$	E_o(ev)	$\Gamma(10^{-3}$ev)	$\Gamma_\gamma(10^{-3}$ev)
23 3	6.70 6	26 2	24 2
27 6	21.1 2	38 6	30 6
30 10	37.1 4	70 20	40 20

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Resonances $U^{(238)}(n)$ chopper

$\sigma_o(10^3 b)$	E_o(ev)	Γ_n(mev)*	Γ_γ(mev)
20.0 18	6.69 2.5	1.15 4	21.2 13
17.0 25	21.0 1	6.35 59	36.0 35
25.0 75	37.0 4	22.0 35	34 10
14 10	67.7 8	19.1 45	25 12
	83 11	2.7 11	21 15
	90 12	0.09 8	
	105 1.4	52 5	
	120 2	38 2	
	135 2.3	2.4 19	
	142 2.4	0.5 4	
	146 2.5	4 3	
	165 3	0.97	
	194 3.5	119 10	
	202 4	75 6	
	240 5	70 21	
	254 6	20 11	
	272 7	55 7	
	291 8	148 1	
	355 10	140 90	
	405 12	260 80	

*Assuming $\bar{\Gamma}_\gamma$ = 30 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Np^{234} 93 141 4.4^d

$\gamma(U^{234})$	0.043	L_2/L_3 = 1.4	sl ce,
	0.099 ?		scin
	0.109	0.740*	
	0.151	0.752	
	0.234	0.780*	
	0.247	0.810	
	0.449	0.940*	
	0.486	1.010*	
	0.502*	1.200*	
	0.516	1.565	

(0.502 γ)(0.449, 0.740, 1.010 γ) scin

(0.740 γ)(0.449, 0.780 γ)

(0.940 γ)(0.502, 0.585 γ) *scin only

J.R.Huizenga, D.W.Engelkemeir, M.S.Freedman, P.T.Porter, J.T.Gindler, Bull. Am. Phys. Soc. 1, No. 4, 171 E7 (1956); verbal report.

Np^{235} 93 142 410^{d}

$\gamma(Pa^{231})$ **0.026** scin $\alpha\gamma$
0.085

$\alpha\gamma$ delay = $37^{m\mu s}$ 4
$\alpha/\epsilon = 3.5 \times 10^{-5}$ 4
$(0.085\gamma)/\alpha = 0.054$ 5

x	762†	U K x rays			scin
	4600†	U L_{α} x ray	106†	$x_K x_{L\alpha}$	pc
	4240†	U L_{β} x ray	89†	$x_K x_{L\beta}$	
	1080†	U L_{γ} x ray	12†	$x_K x_{L\gamma}$	

No $\gamma(U^{235})$
$\therefore \epsilon_L/\epsilon_K = 30$ 2 and $E_{dis} = 0.130$. Used $\omega_K = 0.98$, $\omega_L = 0.42$, and the measured ratio $(x_L - x_L x_K)/x_K$

R.W.Hoff, J.L.Olsen, L.G.Mann, Phys. Rev. 102, 805 (1956).

Np^{236} 93 143 22^{h}

β^- **0.518** *10** sl

		L : M : N	
γ	**0.0435** *10*	48 : 18 : 3	sd ce
	0.0442 *10*		

No 0.150γ (0.038 ce now interpreted as ce_M 0.044γ's rather than ce_K 0.150γ)
ce/β~0.35

P.R.Gray, Phys. Rev. 101, 1306 (1956); *G.D. O'Kelley, ibid.

Np^{237} 93 144 2.2×10^{6}y

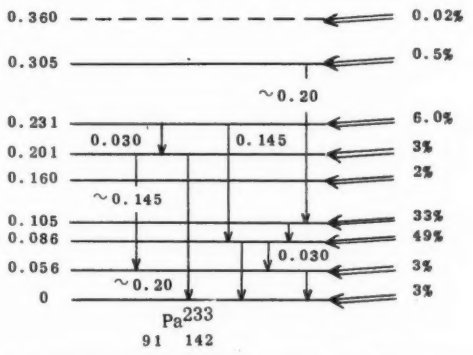
α	0.02%	4.52	33%	4.767	ic
	0.5%	4.589	49%	4.787	
	6.0%	4.644	3%	4.816	
	3%	4.674	3%	4.872	
	2%	4.713			

$\gamma(Pa^{233})$ scin, pc, s ce

<3†	**0.020**	$\alpha > 10$
16†	**0.029**	$\alpha_L = 2.8$
<1†	**0.0568**	$\alpha_L > 44$
16†	**0.0869**	$\alpha_L = 0.75$
1†	**0.145**	$\alpha_L = 0.15$
0.1†	**0.175**	
0.3†	**0.200**	

x(Pa) 130† L x ray
5† K x ray

†Photons per 100 α's
Level scheme supported by $\alpha\gamma$, $\gamma\gamma$, α(ce)



L.B.Magnusson, D.W.Engelkemeir, M.S.Freedman, F.T.Porter, F.Wagner, Jr., Phys. Rev. 100, 1237A (1955); verbal report.

Np^{237} 93 144 2.2×10^{6}y

α's emitted preferentially in the direction perpendicular to nuclear axis $\alpha(\theta, T)$
$W(\theta) = 1 - 0.07 P_2(\cos\theta)$ at 1.1°K

L.D.Roberts, J.W.T.Dabbs, G.W.Parker, H.D. Ellison, Bull. Am. Phys. Soc. 1, No. 4, 207 R8 (1956).

Np^{239} 93 146 2.3^{d}

τ **2.346**^{d} 4 $U^{(238)}(n,\gamma)$ chem

L.Wish, Nucleonics 14, No. 5, 102 (1956).

$\gamma(Pu^{239})$ $U^{(238)}(n,\gamma\beta)$ chem

16†	**0.44**	4π ic, scin
19†	**0.49**	

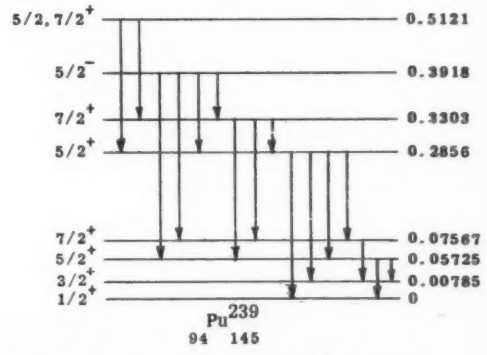
†Photons per 10^5 β's

H.W.Lefevre, E.M.Kinderman, H.H.Van Tuyl, Phys. Rev. 100, 1374 (1955).

$\gamma(Pu^{239})$ U^{238}(pile n,$\gamma\beta$) chem

~300*	**0.04464**	M1/E2 = 4	π ce
475*	**0.04940**	M1/E2 = 2.3	
1275*	**0.05725**	M1/E2 < 0.05	
~10*	**0.0614**	E1 (ce_{L1} only)	
800*	**0.06782**	E2	
500*	**0.1061**	E1	
	0.1064		
	0.1253?		
	0.1818		
700*	**0.2099**	M1/E2 > 2.3	
	0.2264		
1980*	**0.2284**	M1/E2 > 4	
	0.2546		
	0.2731		
1400*	**0.2778**	M1/E2 > 9	
	0.2856		
	0.3161		
	0.3345		

Multipole mixtures from $L_1 : L_2 : L_3$
*Relative ce intensity (assuming L/MN~3)
(~0.23γ)(~0.23γ)/(~0.23γ)(~0.275γ) = 2
Proposed decay scheme suggests J = 5/2 or 3/2 for Np^{239} g.s.



J.M.Hollander, W.G.Smith, J.W.Mihelich, Phys. Rev. 102, 740 (1956); 100, 1238A (1955); §D.Strominger, ibid.

$Np^{240}_{93\ 147}$ 1^h g.s.

$\gamma(Pu^{240})$			$Np^{239}(n,\gamma)$ chem
	72†	0.88	scin
	100†	0.97	
	9†	1.14	

H.W.Lefevre, E.M.Kinderman, H.H.Van Tuyl, Bull. Am. Phys. Soc. 1, No. 1, 62 UA6 (1956); verbal report.

$Np^{240}_{93\ 147}$ 7.3^m

Not p $1^h Np^{240}$ (< 5%)

H.W.Lefevre, E.M.Kinderman, H.H. Van Tuyl, Bull. Am. Phys. Soc. 1, No. 1, 62 UA6 (1956).

$Pu^{238}_{94\ 144}$ 90^y

α	31%	5.4499 *7*	sd
	69%	5.4909 *5*	

L.L.Gol'din, E.F.Tret'yakov, G.I.Novikova, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL Trans. 242.

$Pu^{239}_{94\ 145}$

ground state

J 1/2 S

L.A.Korostyleva, A.R.Striganov, N.M.Iashin, Zhur. Eksptl' i Teoret. Fiz. 28, 471 (1955); Soviet Phys. JETP 1, 310 (1955); Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 31 (1955).

N.I.Kaliteevskii, M.P.Chaika, Doklady Akad. Nauk SSSR 103, 49 (1955).

$Pu^{239}_{94\ 145}$ 2.4×10^{4y}

α	10.7%	5.0963 *3*	sd
	16.8%	5.1344 *3*	
	72.5%	5.1474 *2*	
$\gamma(U^{235})^*$		0.0125	sd ce
		0.0383	
		0.0508	

No other α's from 4.9 to 5.33 (< 0.2%)

L.L.Gol'din, E.F.Tret'yakov, G.I.Novikova, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL Trans. 242. *K.N.Shlyagin, ibid.

$\gamma(U^{235})_{120}$* { ~0.038 ~0.050 ppl α (ce)

ce ~1* ~0.10

(ce 0.038 γ)(ce ~0.01γ)/α = 0.013 *4*

*ce per 1000 α's

G.Albouy, Ann. Phys. 1, 99 (1956).

$Pu^{239}_{94\ 145}$? 155 tracks (range 100 to 300 μ) observed in ppl from Pu^{239} source. Similiar tracks seen with active deposit of Po, Ac, and Th

M.Ader, Compt. rend. 241, 1748 (1955).

$Pu^{240}_{94\ 146}$ 6580^y

τ		6600^y *100*	Pu^{239}(pile n,γ) chem specific activity

J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 634; Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

α	0.085%	5.004	sd
	24.5%	5.1147 *5*	
	75.5%	5.1589 *3*	
$\gamma(U^{236})^*$		0.0446	sd ce

Transition to 6^+ level not yet detected

L.L.Goldin, G.I.Novikova, E.F.Tretyakov, Phys. Rev. 103, 1004 (1956); Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 226 July (1955); UCRL-Trans. 242; *K.N.Shlyagin, ibid.

$Pu^{240}_{94\ 146}$

Resonances	$Pu^{239}(n)$ E_o(ev)	Γ(ev)	chopper, cryst $g\Gamma_n$(mev)
$\sigma_o\Gamma^2 = 1.6$	0.01	0.063	0.001
$\sigma_o = 5300$	0.300 *5*	0.101 *5*	0.063 *3*

Resonances also observed at 7.8, 11.3, 16 ev

N.J.Pattenden, J. Nuclear Energy 2, 187 (1956).

Resonances	$Pu^{239}(n)$	E_n = 0.03 to 20 ev
	0.297 ev	11.5 chopper
	8	15

$Pu^{239}(n,f)$ $E_n = 10^{-3}$ to 100 ev
0.297 *3* Γ=90 *10* mev cryst
σ_o = 3000

J.M.Auclair, M.Galula, P.Hubert, B.Jacrot, R.Joly, F.Netter, G.Vendryes, Geneva Conf. 8/P/354 (1955).

Resonance	$Pu^{239}(n)$	
0.300 *5* ev	Γ = 105 *5* mev	cryst
	σ_o = 4600 *300*	

N.Galanina, K.Ignatyev, S.Nikitin, S. Sukhoruchkin, quoted by Yu.G.Abov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 249 July (1955); Consultants Bureau Trans. p. 209.

Pu^{240} 94 146

Resonances $Pu^{239}(n,f)$

0.3 ev	
7.8	17.6
11.0	22.2
11.9	42
14.3	44.5
14.7	50
15.3	53

R.E.Cotè, L.M.Bollinger, J.M.LeBlanc, G.E. Thomas, Bull. Am. Phys. Soc. 1, No. 4, 187 K5 (1956).

Resonances $Pu^{239}(n,f)$ E_n = 0.007 to 700 ev
0.297 ev Γ = 98 *3* mev cryst,
σ_o = 2940 *100* chopper

E_o(ev)	σ_o^*	E_o(ev)	σ_o^*
8.0 *2*	840	18.3 *5*	750
11.2 *3*	1930	22.8 *7*	1030
15.1 *4*	1530	26.8 *9*	490

*Assuming Γ = 100 mev

R.Richmond, B.T.Price, J. Nuclear Energy 2, 177 (1956).

Pu^{241} 94 147 13^y

τ 12.95^y *28* Pu chem
From growth of 0.060γ of 461.3^y Am^{241}

B.Rose, J.Milsted, J. Nuclear Energy 2, 264 (1956).

τ 12.8^y *3*
From growth of Am^{241}

J.Mech, G.Pyle, ANL-4926 (1953); NSA 10, No. 2556 (1956).

τ_a 2.9 x 10^{5y} *5*
From equilibrium activity of 6.75^d U^{237}

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, KAPL-1378 (1955).

Pu^{241} 94 147

Resonance $\sigma_o(10^5$b)	Pu^{240}(n) E_o(ev)	chopper, cryst Γ_n(mev)	Γ_γ(mev)
1.5 *2*	1.06 *1*	1.80 *40*	27 *6*

N.J.Pattenden, J.Nuclear Energy 2, 187 (1956).

Resonance $\sigma_o(10^5$b)	$Pu^{(240)}$(n) E_o(ev)	Γ(mev)	cryst Γ_n(mev)
1.78 *16*	1.075 *5*	42 *5*	6.2 *9*

Y.G.Abov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p.249 July (1955); Consultants Bureau Trans. p.209.

Pu^{242} 94 148 $3.8x10^{5y}$

Pu^{239}(pile n) chem; ms
τ 3.79 x 10^{5y} *5* specific activity

J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 634; Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

Am^{241}(pile n,$\gamma\epsilon$) chem
τ 3.73 x 10^{5y} *5* ic,ms
From ratios of α's and atoms of Pu^{242} and Pu^{238} using τ = 89.6^y for Pu^{238}
τ for spontaneous fission = 6.64 x 10^{10y} *10*

J.P.Butler, M.Lounsbury, J.S.Merritt, Can. J. Chem. 34, 253 (1956).

Pu(pile n) chem; ms
τ_a 3.88 x 10^{5y} *10* ic
Based on $\tau(Pu^{240})$ = 6580^y
τ for spontaneous fission = 7.1 x 10^{10y} *2*

J.Mech, H.Diamond, M.H.Studier, P.R.Fields, A.Hirsch, C.M.Stevens, R.F.Barnes, D.J. Henderson, J.R.Huizenga, Phys. Rev. 103, 340 (1956).

Pu(pile n) chem
τ for spontaneous fission ~ 8.5 x 10^{10y}

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, KAPL-1378 (1955).

Pu^{242} 94 148

Resonances Pu^{241}(n,f) E_n = 0.01 to 9 ev
0.255 *20* Γ = 103 *20* mev cryst,
σ_o = 1420 *150* chopper
4.45 *10* Γ = 470 mev (double?)
5 to 7.5 3 resonances

R.Richmond, B.T.Price, J. Nuclear Energy 2, 177 (1956).

Pu^{244} 94 150 $7.5x10^{7y}$

τ ~ 7.5 x 10^{7y} *2* Pu^{239}(pile n) chem
From milking of 14^h U^{240} from Pu ms

J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 634; Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

Pu(pile n) chem; ms
τ 7.6x10^{7y} *20* counted 7.3^m Np^{240}

H.Diamond, R.Barnes, Phys. Rev. 101, 1064 (1956).

Pu^{244} 94 150 7×10^{7y}

τ for spontaneous fission = 2.5×10^{10y} *8*

P.R.Fields, J.E.Gindler, A.L.Harkness, M.H. Studier, J.R.Huizenga, A.M.Friedman, Phys. Rev. 100, 172 (1955).

Pu^{245} 94 151 10^{h}

τ	**10.6^{h}** *4*	Pu^{244}(pile n,γ) chem	

From milking of $2.0^{h}Am^{245}$ from Pu

J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 634; Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

τ	**10.1^{h}** *5*	Pu^{244}(pile n,γ) p $25^{m}Am$ chem

P.R.Fields, M.H.Studier, A.M.Friedman, H. Diamond, R.Sjoblom, P.A.Sellers, J. Inorg. Nucl. Chem. 1, 262 (1955).

τ	**12^{h}** *1*	Pu^{239}(pile n) chem

C.I.Browne, D.C.Hoffman, W.T.Crane, J.P. Balagna, G.H.Higgins, J.W.Barnes, R.W.Hoff, H.L.Smith, J.P.Mize, M.E.Bunker, J. Inorg. Nucl. Chem. 1, 254 (1955).

Pu^{246} 94 152 11^{d}

τ	**11.2^{d}** *2*	H-bomb debris, chem; ms		
β^-	**0.15**			a
$\gamma(Am^{246})$	**0.043**		**0.175**	scin
	0.111 *3*		**0.224** *10*	

p $25^{m}Am$ chem

D.Engelkemeir, P.R.Fields, S.Fried, G.L.Pyle, C.M.Stevens, L.B.Asprey, C.I.Browne, H.L. Smith, R.W.Spence, J.Inorg. Nuclear Chem. 1, 345 (1955).

τ		**10.85^{d}** *2*			
β^-	73%	**0.15** *1*			scin $\beta\gamma$
	27%	**0.33** *3*			
$\gamma(Am^{246})$					scin $\gamma\gamma$
	330†	**0.027** *3*	$\alpha \leq 1.9$		γ/γ
	780†	**0.047** *2*	$\alpha \leq 0.23$		γ/γ
	90†	**0.075 to 0.085**			
	w	**0.099** *5*			
	84†	**0.175** *5*	$\alpha_K \sim 6$	K/L = 4.8*	x/γ
		0.215 *10*			scin
x	500†	K x ray			

(0.15β)(0.047, 0.175γ) (0.33β)(0.047γ)
(0.175 γ)(0.027, 0.047, 0.070? γ)
(0.047γ)(0.027, 0.075 to 0.085, 0.099, 0.175γ, L x ray, K x ray)
No 0.40β (< 5% from equality of intensity of Pu^{246} and Am^{246} β's

D.C.Hoffman, C.I.Browne, J. Inorg. Nuclear Chem. 2, 209 (1956); *H.L.Smith et al., ibid.

Am^{239} 95 144 12^{h}

α	0.003%*				Pu^{239}(18-Mev d,2n)
$\gamma(Np^{235})$	5†	**0.0483** *15*	E1		pc
α(0.048γ)					

†Photons per 10 α's

F.Asaro, F.S.Stephens,Jr., W.M.Gibson, R.A. Glass, I.Perlman, Phys. Rev. 100, 1541 (1955); *G.H.Higgins, ibid.

Am^{241} 95 146

	ground state	
J	**5/2**	S
q	**large**	

R.Thorne, Nature 178, 484 (1956).

	ground state	
μ	**+1.4**	S
q	**+4.9**	

T.E.Manning, M.Fred, F.S.Tomkins, Phys. Rev. 102, 1108 (1956).

Am^{241} 95 146 461^{y}

τ	**461.3^{y}** *17*	specific activity

G.R.Hall, T.L.Marken, J. Inorg. Nuclear Chem. 2, 202 (1956).

α	0.002%	**5.241?** *5*			sd
	0.015%	**5.321** *3*	85%	**5.4820** *6*	
	1.66%	**5.3860** *5*	0.24%	**5.5082** *5*	
	12.7%	**5.4391** *6*	0.39%	**5.5408** *6*	

L.L.Goldin, G.I.Novikova, E.F.Tretyakov, Phys. Rev. 103, 1004 (1956); Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math Sci. p. 226 July (1955); UCRL-Trans. 242.

$\gamma(Np^{237})$ d Pu^{241}; sd ce

		L_1:	L_2 :	L_3	
85*	**0.02638**	9	20	13	E1
119*	**0.03322**	51	12	12	M1 + (E2?)
137*	**0.04343**	40	33	26	E2 + M1
10*	**0.05552**	4	3		
350*	**0.05962**	73	155	33	E2/M1 = 9
	0.09880				

*Relative ce intensities

S.A.Baranov, K.N.Shlyagin, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 251 July (1955); Consultants Bureau Trans. p. 183.

$Am^{241}_{95\ 146}$ 461^{y}

$\gamma(Np^{237})$ scin

	27†	**(0.0264)**	370†	**(0.0596)**
	~0.6†	**(0.0434)**	0.2†	**(0.0988)**
x	370†	**L x ray**		

†Photons per 10^3 α's

L.B.Magnusson, D.W.Engelkemeir, Bull. Am. Phys. Soc. 1, No. 4, 171 E8 (1956); verbal report.

$\gamma(Np^{237})$

	$L_1:L_2:L_3$	$M_1:M_2:M_3:M_{45}$
(0.033)		~4 : ~1: 1
(0.043)	10: 10: 10	
(0.056)	~1: 1	~1 : ~1: 1
(0.060)*	15: 33: 10	17 : 36: 10: 1
(0.099)	~0: >1: 1	

*L:M:N:O = 10:3:1:~0.3 sπ ce

J.M.Hollander, W.G.Smith, J.O.Rasmussen, Phys. Rev. 102, 1372 (1956).

$Am^{242}_{95\ 147}$ 100^{y} g.s.

β^-	90%	**0.585** *10*	$Am^{241}(n,\gamma)$ chem; sd
ϵ_K	10%		scin Pu K x ray
No ce observed			sd ce

45 ± 10% of β's to 0.042 Cm^{242} level from β(L x ray)/β

R.W.Hoff, H.Jaffe, T.O.Passell, F.S.Stephens E.K.Hulet, S.G.Thompson, Phys. Rev. 100, 1403 (1955).

$Am^{242}_{95\ 147}$ 16^{h}

τ		**16^h**	$Am^{241}(n,\gamma)$ chem
β^-	~49%	**0.625** 5	ΔJ = 2, yes shape sd
	~33%	**0.667** 5	F-K assumed linear
ε	(~18%)		pc Pu K_α, K_β x rays

$\gamma(Cm^{242})$

		L_2 : L_3 : M : N	
559*	**0.0422**	222 : 163 : 120 : 54	E2

$\gamma(Am^{242})$

< 50*	**0.0451**		

$\gamma(Pu^{242})$

128*	**0.0445**	69 : 34 : 18 : 7	E2

*ce per 1000 β^-

S.A.Baranov, K.N.Shlyagin, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p. 251 July (1955); Consultants Bureau Trans. p. 183.

β^-	81%$	**0.620** *10*	$Am^{241}(n,\gamma)$ chem; sd
ε	19%$		Pu^{242}/Cm^{242}
$\gamma(Cm^{242})$			sd ce
100*	**0.0422** *3***	L_2/L_3 = 1.4 *4*	E2

$\gamma(Pu^{242})$

40*	**0.0446** *3***	L_2/L_3 = 1.4 *4*	E2

No IT (<6% from L x ray intensities) cryst

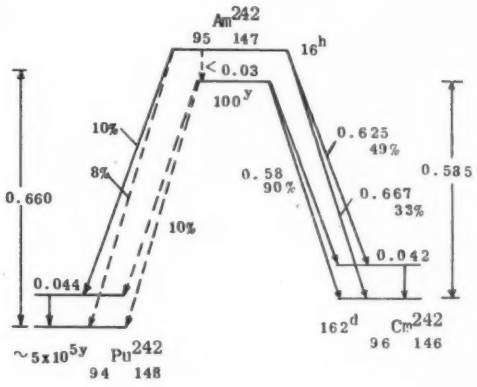
No IT γ with E_γ > 0.030 sd ce

51 ± 5% of β's to 0.042 Cm^{242} level from β(L x ray)/β

*Relative ce_L intensities

R.W.Hoff, H.Jaffe, T.O.Passell, F.S.Stephens, E.K.Hulet, S.G.Thompson, Phys. Rev. 100, 1403 (1955); $G.H.Higgins, S.G.Thompson, ibid.; **E.L.Church, ibid.

$Am^{242}_{95\ 147}$



$Am^{243}_{95\ 148}$

	ground state	
μ	**+1.4**	S
q	**+4.9**	

$\mu(Am^{241})/\mu(Am^{243})$ = +1.00 *1*

$q(Am^{241})/q(Am^{243})$ = +1.00 *1*

T.E.Manning, M.Fred, F.S.Tomkins, Phys. Rev. 102, 1108 (1956).

$Am^{243}_{95\ 148}$ 8800^{y}

α(0.075 γ) delay < $2^{m}\mu s$

D.Strominger, J.O.Rasmussen, Phys. Rev. 100, 844 (1955).

$Am^{244}_{95\ 149}$ 26^{m}

ϵ/β^- = 3.9×10^{-4} Am^{243}(pile n,γ) chem; ms

From Pu^{244}, Cm^{244} yield

P.R.Fields, J.E.Gindler, A.L.Harkness, M.H. Studier, J.R.Huizenga, A.M.Friedman, Phys. Rev. 100, 172 (1955).

$Am^{245}_{95\ 150}$ 2.0^{h}

τ	**2.07^h** 2	Pu^{244}(pile n) chem

J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 634; Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

τ	**2.08^h** *8*		Pu^{239}(pile n) chem
β^-	**0.905** 5		sl
$\gamma(Cm^{245})$	**0.036** 5	**0.140** 5	scin γγ
	0.060 ?	**0.153** 5	
	0.078 ?	**0.230** 5	
	0.111* 5	**0.255$** 5	
	0.123 5		

α_K = 0.19 K/L = 5 E1 sl ce

(0.255 γ)(0.036, 0.06?, 0.078?, 0.11*, 0.12, 0.15 γ)

(0.230 γ)(0.036, 0.06?, 0.078?, 0.11*, 0.14 γ)

(0.11* γ)(0.11*, 0.14, 0.230, 0.255 γ) *K x ray?

C.I.Browne, D.C.Hoffman, W.T.Crane, J.P. Balagna, G.H.Higgins, J.W.Barnes, R.W.Hoff, H.L.Smith, J.P.Mize, M.E.Bunker, J. Inorg. Nucl. Chem. 1, 254 (1955).

$Am^{245}_{95\ 150}$ 2.0^h

τ	**1.98^h** *2*		d 2.0^{h}Pu chem
β^-	**~0.86**		a
$\gamma(Cm^{245})$	**0.121**		scin
	0.260		

P.R.Fields, M.H.Studier, A.M.Friedman, H. Diamond, R.Sjoblom, P.A.Sellers, J. Inorg. Nucl. Chem. 1, 262 (1955).

$Am^{246}_{95\ 151}$ 25^m

τ	**25^m**	p~3000^{y}Cm chem

C.I.Browne, D.C.Hoffman, W.T.Crane, J.P. Balagna, G.H.Higgins, J.W.Barnes, R.W.Hoff, H.L.Smith, J.P.Mize, M.E.Bunker, J. Inorg. Nucl. Chem. 1, 254 (1955).

τ	**25.0^m** *2*		d 11^{d}Pu chem
β^-	**1.222**		scin $\beta(1.069\gamma)$
w	**>1.2**		scin
$\gamma(Cm^{246})$	**~0.10** (K x ray ?)		$(1.069\gamma)\gamma$
	~0.20		
	0.795		scin
	1.069		
x	**L x ray**		

$(1.069\gamma)(1.22\beta, \sim 0.10, \sim 0.20\gamma)$

$(\sim 0.10\gamma)(1.069\gamma)/(\sim 0.10\gamma) = 0.04$

D.Engelkemeir, P.R.Fields, S.Fried, G.L.Pyle, C.M.Stevens, L.B.Asprey, C.I.Browne, H.L. Smith, R.W.Spence, J.Inorg. Nucleur Chem. 1, 345 (1955).

$Cm^{242}_{96\ 146}$ 162^d

$\gamma(Pu^{238})$	**0.04411** *5*	$L_2/L_3 = 1.2$	sπ ce
		$M_2/M_3 = 1.2$ $N_2/N_3 \sim 1$	
		L:M:N = 26:10:3	
	0.1019 *3*	$M_2/M_3 = 1.5$ L/M~3	
		$L_1:L_2:L_3 = \sim 2:14:10$	
	0.1577 *5*		

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 746 (1956).

$\gamma(Pu^{238})$	**0.562**	E1	scin
	0.605	E1	

E1 assignment from systematics

F.S.Stephens,Jr., F.Asaro, I.Perlman, Phys. Rev. 100, 1543 (1955).

$Cm^{244}_{96\ 148}$ 18^y

$\gamma(Pu^{240})$	**0.04288** *5*	$L_2/L_3 = 1.0$	sπ ce
		$M_2/M_3 = 1.0$ $N_2/N_3 \sim 1$	
		L:M:N = 25:10:3	

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 746 (1956).

$Cm^{245}_{96\ 149}$ $.4 \times 10^{4y}$

τ	**1.43x10^{4y}** *29*	d 2.0^{h}Am chem

C.I.Browne, D.C.Hoffman, W.T.Crane, J.P. Balagna, G.H.Higgins, J.W.Barnes, R.W.Hoff, H.L.Smith, J.P.Mize, M.E.Bunker, J. Inorg. Chem. 1, 254 (1955).

τ	**2300^y** *460*	d 25^{m}Am chem

C.I.Browne, D.C.Hoffman, W.T.Crane, J.P. Balagna, G.H.Higgins, J.W.Barnes, R.W.Hoff, H.L.Smith, J.P.Mize, M.E.Bunker, J. Inorg. Nucl. Chem. 1, 254 (1955).

$Cm^{246}_{96\ 150}$ ~3000^y

Pu(pile n)Cf chem

τ_α	**6600^y** *300*	
α	**5.373** *10*	ic

τ from relative disintegration rates of Cf^{250} and Cm^{246} and $\tau = 9.3^y$ for Cf^{250}

J.P.Butler, T.A.Eastwood, H.G.Jackson, R.P. Schuman, Phys. Rev. 103, 965 (1956).

H-bomb debris chem

τ for spontaneous fission **2.0×10^{7y}** *8*

S.M.Fried, G.L.Pyle, C.M.Stevens, J.R. Huizenga, J.Inorg. Nuclear Chem. 2, 415 (1956).

α	**5.4**	H-bomb debris chem, ms ic

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

$Cm^{248}_{96\ 152}$ 4.7×10^{5y}

Pu(pile n)Cf chem

τ_α	**4.7×10^{5y}** *4*	
α	**5.054** *15*	ic

τ from relative disintegration rates of Cf^{252} and Cm^{248} and $\tau = 2.2^y$ for Cf^{252}

τ for spontaneous fission = **4.6×10^{6y}** *5*

J.P.Butler, T.A.Eastwood, H.G.Jackson, R.P. Schuman, Phys. Rev. 103, 965 (1956).

$Cm^{249}_{96\ 153}$ 65^m

τ	**65^m**	Cm(pile n)
β^-	**0.9**	

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

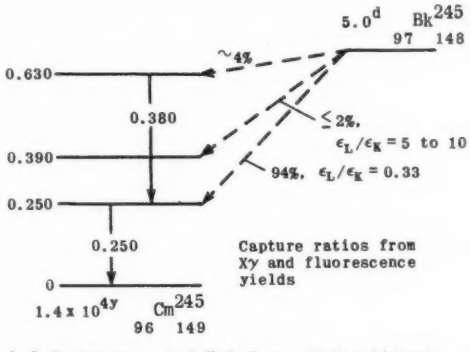
$Cm^{250}_{96\ 154}$ τ_β $>130^y$
From absence of Cf^{250} in H-bomb debris

P. R. Fields, M. H. Studier, H. Diamond, J. F. Mech, M. G. Inghram, G. L. Pyle, C. M. Stevens, S. Fried, W. M. Manning, A. Ghiorso, S. G. Thompson, G. H. Higgins, G. T. Seaborg, Phys. Rev. 102, 180 (1956).

$Bk^{245}_{97\ 148}$ 5.0^d

τ		**4.96**^{d} 2		Cm^{244}(d,n), $Am^{243}(\alpha,2n)$ chem
α	0.22†	**5.89** 2		ic
	0.34†	**6.17** 2		
	0.28†	**6.37** 2		
$\gamma(Cm^{245})$				scin, sl ce
	245†	**0.250**	$\alpha_K = 1.76$ 8	$\alpha_L = 0.44$
	40†	**0.380**	$ce_K/\gamma = 0.2$ (double?)	
x	620†	**L x ray**		
	1000†	**K x ray**		

(0.25 γ)(0.38γ, K x ray, L x ray)
(K x ray)($E_\gamma > 0.05$) delay $< 2^{m\mu s}$
No 0.068γ No γ with $E_\gamma > 0.46$ (<2†)



L. B. Magnusson, A. M. Friedman, D. Engelkemeir, P. R. Fields, F. Wagner, Jr., Phys. Rev. 102 1097 (1956).

$Bk^{248}_{97\ 151}$ 23^h τ **23**^{h} 5 Cm(25-Mev α) chem
From milking of 250^dCf^{248} (6.3 α observed)

E. K. Hulet, Phys. Rev. 102, 182 (1956).

$Cf^{244}_{98\ 146}$ 25^m

τ		**25**^{m} 3	$Cm^{242}(\alpha,2n)$ chem
α		**7.17** 2	ic

p 27^dCm
Relative yields of 7.17α, 7.11α consistent with assignment to Cf^{244}, Cf^{245} respectively

A. Chetham-Strode, Jr., G. R. Choppin, B. G. Harvey, Phys. Rev. 102, 747(1956).

$Cf^{245}_{98\ 147}$ 45^m

			$Cm^{244}(\alpha,3n)$ chem
α		**7.11** 2	ic

$\alpha/\epsilon \sim 30/70$ from growth of 5.0^dBk^{245}
Bases of mass assignment: Relative yields of 7.17α, 7.17α(see Cf^{244}); not parent of 27^dCm (insufficient growth of 6.26α); $\alpha x_L/\alpha < 2\%$
45^mCf previously assigned to Cf^{244}

A. Chetham-Strode, Jr., G. R. Choppin, B. G. Harvey, Phys. Rev. 102, 747 (1956).

$Cf^{249}_{98\ 151}$ $\sim 470^y$

$\gamma(Cm^{245})$				d Bk^{249} chem
	16†	**0.340**		scin $\alpha\gamma$
	60†	**0.395**		

α(0.340, 0.395γ)
†Photons per 100 α's

F. Asaro, F. S. Stephens, Jr., B. G. Harvey, I. Perlman, Phys. Rev. 100, 137 (1955).

$Cf^{250}_{98\ 152}$ 10^y

α	17%	**5.980**		Cm^{244}(pile n); s
	83%	**6.024** 5		

F. Asaro, F. S. Stephens, Jr., B. G. Harvey, I. Perlman, Phys. Rev. 100, 137 (1955).

α		**6.025** 5	Pu(n) chem

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, KAPL-1378 (1955).

$Cf^{251}_{98\ 153}$? $>18^d$

$\gamma(Cm^{247}?)$		**0.180**	scin $\alpha\gamma$

F. Asaro, F. S. Stephens, Jr., B. G. Harvey, I. Perlman, Phys. Rev. 100, 137 (1955).

$Cf^{252}_{98\ 154}$ 2.2^y

α	15.5%	**6.069**		Cm^{244}(pile n); s
	84.5%	**6.112** 5		
$\gamma(Cm^{248})$				scin $\alpha\gamma$
	14†	**0.042**	$\alpha = 1100$	E2
	13†	**0.100**		

α(0.042, 0.100γ)
†Photons per 10^5 α's

F. Asaro, F. S. Stephens, Jr., B. G. Harvey, I. Perlman, Phys. Rev. 100, 137 (1955).

α		**6.119** 5	Pu(n) chem

α/fission = 38.0 7

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, KAPL-1378 (1955).

$Cf^{254}_{98\ 156}$ 55^d

τ **55^d** H-bomb debris chem

Decays by spontaneous fission

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

$E^{253}_{99\ 154}$ 20^d

τ		**20.03^d** *1*		Pu(pile n) chem
α	~0.08%	**6.24** *2*		ic
	100%	**6.636** *5*		
$\gamma(Bk^{249})$				scin
	3.8†	**0.042** *3*	α_L~34 (ω_L = 0.50)	x/γ
	5.5†	**0.393** *5*	α_K~0.66	x/γ
x	65†	**L x ray**		
	3.6†	**K x ray**		

(6.24 α)(0.393 γ)

τ for spontaneous fission = 7 x 10^{5y} *3*

†Photons per 10^4 α's

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$E^{254}_{99\ 155}$ ~320^d g.s.

τ		**~320^d**	Pu(pile n) chem
α		**6.42** *2*	ic
p $3^h Bk^{250}$			recoil

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$E^{254}_{99\ 155}$ 38^h

τ		**38.5^h** *10*	Pu(pile n) chem
β^-		**1.04** *4*	a
$\gamma(Fm^{254})$			
	~70†	**0.660** *15*	scin

†Photons per 100 β's

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$E^{255}_{99\ 156}$ 24^d

τ		**24^d** *2*	Pu(pile n) chem
p $22^h Fm^{255}$ (α pulse analysis)			

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$Fm^{252}_{100\ 152}$ 23^h

τ		**22.7^h** *7*	Cf(34-Mev α) chem
α		**7.04** *2*	ic

p $250^d Cf^{248}$ (from increase of 6.3 α)

τ for spontaneous fission > 3000^d

A.M.Friedman, J.E.Gindler, R.F.Barnes, R. Sjoblom, P.R.Fields, Phys. Rev. 102, 585 (1956).

$Fm^{253}?_{100\ 153}$ $>10^d$

τ		**>10^d**	Cf(34-Mev α) chem
α		**6.85**	ic

A.M.Friedman, J.E.Gindler, R.F.Barnes, R. Sjoblom, P.R.Fields, Phys. Rev. 102, 585 (1956).

$Fm^{254}_{100\ 154}$ 3.2^h

τ		**3.24^h** *1*	Pu(pile n) chem
α		**7.20** *1*	ic

τ for spontaneous fission = 246^d

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$Fm^{255}_{100\ 155}$ 22^h

τ		**21.5^h** *1*	Pu(pile n) chem
α		**7.08** *1* double ?	ic

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

2. NEUTRON CROSS SECTIONS

Absorption cross sections for neutron energies marked "th" (thermal) have been determined, from measurements in a thermal neutron flux, in terms of the cross section value of a "standard" for neutrons of velocity 2200 m/sec, or energy ~ 0.025 ev. The standard used, when clearly stated by the experimenter, is given just after the reference and is generally one known to have a thermal absorption cross section with 1/v energy dependence. If the nucleus whose cross section is being measured also has a cross section with 1/v dependence, the cross section found for it by comparison with the standard will, of course, be a cross section for 2200 m/sec. If not, and the dependence often is not known, the value found by the comparison is $\overline{\sigma v}/2200$.

Cross sections for inelastic scattering are given in a way which indicates the experimental method used. For instance, "n, 2.00n′ (90°)" in the "Type of σ" column, means that the cross section given is for the production of 2.00-Mev neutrons at 90° to the incident beam (in barns per steradian) and that these neutrons were observed experimentally. The energy of the incoming neutrons is given in the column headed "Energy". If it is 2.45 Mev, the energy loss in the inelastic process was 0.45 Mev. If the σ type is shown as "n,n′ + 1.00γ(90°) the cross section given is for the production of 1.00-Mev γ's In this case γ's, not neutrons, were observed at 90°. The energy lost by the neutron is then 1.00 Mev or more depending on whether or not another γ ray, unobserved in the experiment, was in cascade with the 1.00-Mev γ.

Target	Neutron Energy	Type of σ	Value of σ or $\int\sigma d\Omega$	Method	Ref.
H	th	n,γ	**0.335** *4*	mean life	56M62
	380	t	**0.034** *2*		55D46
	500	t	**0.035** *2*		55D46
	590	t	**0.036** *2*		55D46
	630	t	**0.037** *4*		55D46
H^2	380	t	**0.057** *2*		55D46
	500	t	**0.065** *2*		55D46
	590	t	**0.072** *2*		55D46
	630	t	**0.077** *5*		55D46
He^3	0.120 to 1	n,p	**graph**	He^3 pc	55B146
	0.20 to 22	t	**graph**		56C44
Li	4.4 to 5.5, 7.8 to 8.6	t	**graphs**		56B62
Li^6	0.2 to 0.3	el(θ)	**graphs**	pc	56W04
	0.88 to 6.52	n,α	**table**	pc	56R34
Li^7	0.2 to 0.6	el(θ)	**graphs**	pc	56W04
Be^9	2.56, 2.74	n,n′γ(95°)	**<0.1 mb**	scin γ	56D23
	No 1.8, 2.2γ observed				
	4.4 to 5.5, 7.8 to 8.6	t	**graphs**		56B62
	12.7	t-el	**0.49** *8*	sphere	55T26
	14.1	t-el	**0.37** *8*	sphere	55T26
	380	t	**0.233** *4*		55D46
	500	t	**0.249** *3*		55D46
	590	t	**0.261** *4*		55D46
	630	t	**0.274** *4*		55D46
B	th	n,γ	**761**° *2*	mean life	56C45
	th	n,γ	**760**^{h} *3*	mean life	56C45
	o, Oxford sample				
	h, Harwell standard			Cf NSA 9 24B,p 131	
	4.4 to 5.5, 7.8 to 8.6	t	**graphs**		56B62

Target	Neutron Energy	Type of σ	Value of σ or $\int\sigma d\Omega$	Method	Ref.
B^{10}	2.56	n,n′+0.72γ(95°)	**0.0025** *2*	scin γ	56D23
	4.4 to 5.5, 7.8 to 8.6	t	**graphs**		56B62
	14	n,t2α	**0.102** *17*	ppl	56F18
	14	n,dn′2α	**0.128** *19*	ppl	56F18
$B^{(11)}$	2.59	n,n′+2.14γ(90°)	**0.025**	scin γ	56D01
B^{11}	12.6 to 20.0	n,$\alpha\beta$2α	**graph**	ppl	56A21
C	4.4 to 5.5, 7.7 to 8.6	t	**graphs**		56B62
	12.7	t-el	**0.56** *10*	sphere	55T26
	14.1	t-el	**0.51** *8*	sphere	55T26
	55	t-el	**0.28** *3*	"sphere"	56V11
	81	t-el	**0.20** *2*	"sphere"	56V11
	105	t-el	**0.234** *8*	"sphere"	56V11
	140	t-el	**0.22** *1*	"sphere"	56V11
	380	t	**0.286** *2*		55D46
	500	t	**0.306** *2*		55D46
	590	t	**0.319** *2*		55D46
	630	t	**0.338** *5*		55D46
$C^{(12)}$	6.58	n,n′+4.4γ(95°)	**0.028** *5*	scin γ	56D23
	7.87	n,n′+4.4γ(90°)	**0.060**	scin γ	56H15
N	4.4 to 5.5, 7.8 to 8.6	t	**graphs**		56B62
$N^{(14)}$	th	n,γ	**0.080** *20*	sπ pr	56C04
	3.95	n,n′+2.3γ(95°)	**0.0005** *3*	scin γ	56D23
O	4.4 to 5.5, 7.7 to 8.6	t	**graphs**		56B62
	380	t	**0.376** *6*		55D46
	500	t	**0.398** *4*		55D46
	590	t	**0.407** *5*		55D46
	630	t	**0.422** *9*		55D46
$O^{(16)}$	7.06	n,n′+6.1γ(95°)	**0.0082** *2*	scin γ	56D23

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
F^{19}	2.45	n, 0.99n′(90°)	**0.023**	*3*	pulsed	56C31
	2.45	n, 0.89n′(90°)	**0.023**	*3*	VdG	56C31
	2.56	n, n′ + 0.11γ(95°)	**0.015**	*3*	scin γ	56D23
	2.56	n, n′ + 0.20γ(95°)	**0.043**	*6*	scin γ	56D23
	2.56	n, n′ + 1.23γ(95°)	**0.004**	*1*	scin γ	56D23
	2.56	n, n′ + 1.36γ(95°)	**0.024**	*2*	scin γ	56D23
	2.56	n, n′ + 1.46γ(95°)	**0.005**	*1*	scin γ	56D23
	2.56	n, n′ + 1.56γ 95°)	**0.002**	*1*	scin γ	56D23
	3.1 to 8.0	n, α	graph		$7.4^{s}N$	55M86
	4.4 to 5.5	t	graph			56B62
	4.7 to 8.0	n, p	graph		$29^{s}O$	55M86
Na^{23}	0.80	n, n′ + 0.44γ(100°)	**0.087**	*12*	scin γ	56M54
	2.45	n, 2.01n′(90°)	**0.050**	*10*	pulsed VdG	56C31
Mg	2.45	n, 1.07n′(90°)	**0.024**	*2*	pulsed VdG	56C31
Mg^{24}	0.085	t	60			56T01
$Mg^{(24)}$	2.56	n, n′ + 1.37γ(95°)	**0.049**	*4*	scin γ	56D23
	12.5 to 17.5	n, p	graph		$15^{h}Na$	56C22
$Mg^{(25)}$	2.56	n, n′ + 1.61γ(95°)	**0.015**	*3*	scin γ	56D23
Mg^{26}	pile	n, γ	**0.025**	*2*	$9.5^{m}Mg$	56L06
$Mg^{(26)}$	2.56	n, n′ + 1.83γ(95°)	**0.012**	*2*	scin γ	56D23
Al^{27}	1.75 to 7	t-el	table		sphere	56B49
	2.45	n, 1.43n′(90°)	**0.020**	*2*	pulsed VdG	56C31
	2.56	n, n′ + 0.17γ(95°)	**0.00013**	*3*	scin γ	56D23
	2.56	n, n′ + 0.84γ(95°)	**0.0051**	*6*	scin γ	56D23
	2.56	n, n′ + 1.02γ(95°)	**0.011**	*1*	scin γ	56D23
	2.56	n, n′ + 2.2γ(95°)	**0.0069**	*7*	scin γ	56D23
	3.5 to 14.1	t-el	table		sphere	55T26
	3.6	n, n′ + 2.2γ(100°)	**0.056**	*11*	scin γ	56M54
	3.7	n, n′ + 0.84γ(90°)	**0.022**		scin γ	55R38
	3.7	n, n′ + 1.02γ(90°)	**0.041**		scin γ	55R38
	3.7	n, n′ + 2.2γ(90°)	**0.013**		scin γ	55R38
	13.0 to 16.2	t	graph			56M51
	14	n, p and n, d	**0.13**		ppl	56H01
	55	t-el	**0.50**	*4*	"sphere"	56V11
	81	t-el	**0.41**	*3*	"sphere"	56V11
	105	t-el	**0.43**	*1*	"sphere"	56V11
	140	t-el	**0.42**	*1*	"sphere"	56V11
	380	t	**0.582**	*8*		55D46
	500	t	**0.612**	*4*		55D46
	590	t	**0.631**	*9*		55D46
	630	t	**0.645**	*7*		55D46
Si	3.7	n, n′ + 1.78γ(90°)	**0.064**		scin γ	55R38
Si^{28}	4.4 to 8.0	n, p	graph		$2.3^{m}Al$	56M06
$Si^{(28)}$	12.5 to 17.5	n, p	graph		$2.3^{m}Al$	56C22
P^{31}	1.2	n, n′ + 0.4γ	**<0.05**		scin γ	56V02
	1.2	n, n′ + 0.9γ	**<0.15**		scin γ	56V02
	2.45	n, 1.20n′(90°)	**0.051**	*7*	pulsed VdG	56C31
S	14	el(θ)	graph		scin n	56E03
$S^{(32)}$	2.56	n, p′ + 0.077γ(95°)	**0.0010**	*2*	scin γ	56D23
	2.56	n, n′ + 2.2γ(95°)	**0.014**	*1*	scin γ	56D23
	3.7	n, n′ + 2.2γ(100°)	**0.036**	*7*	scin γ	56M54

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
Cl	0.03 ev	t	44			56B35
	5 kev	t	**1.3**			56B35
$Cl^{(37)}$	12.5 to 17.5	n, p	graph		$5.0^{m}S$	56C22
A	0.07 ev	t	**0.96**			56H08
	0.07 ev	s	**0.61**			56H08
A^{36}	0.07 ev	t	75	*9*		56H08
A^{40}	0.07 ev	s	**0.36**			56H08
$Ca^{(40)}$	3.95	n, p′ + 0.03γ(95°)	**0.010**	*5*	scin γ	56D23
	3.95	n, p′ + 0.77γ(95°)	**0.006**	*1*	scin γ	56D23
	3.95	n, p′ + 0.88γ(95°)	**0.0006**	*3*	scin γ	56D23
	3.95	n, n′ + γ±(95°)	**0.008**	*1*	scin γ	56D23
	3.95	n, n′ + 3.7γ(95°)	**0.006**	*2*	scin γ	56D23
	3.95	n, n′ + 3.9γ(95°)	**0.003**	*1*	scin γ	56D23
$Ca^{(44)}$	3.95	n, n′ + 1.16γ(95°)	**0.090**	*24*	scin γ	56D23
Ti	1.75 to 7	t-el	table		sphere	56B49
	3.5 to 14.1	t-el	table		sphere	55T26
$Ti^{(48)}$	2.25	n, 1.22n′(90°)	**0.075**	*4*	pulsed	56C31
	2.45	n, 1.46n′(90°)	**0.085**	*3*	VdG	56C31
V	2.45	n, 1.53n′(90°)	**0.016**	*1*	pulsed	56C31
	2.45	n, 0.82n′(90°)	**0.018**	*2*	VdG	56C31
Cr	2.45	n, 0.96n′(90°)	**0.048**	*3*	pulsed VdG	56C31
	2.50	n, 1.05n′	**0.6**	*2*	scin n	56B40
	3.5 to 14.1	t-el	table		sphere	55T26
	4.4	el(90°)	**0.037**	*7*	ppl	56W02
	4.4	t(90°)	**0.066**	*17*	ppl	56W02
Mn^{55}	175 to 10^4 ev	t	graph			55B115
	0.1 to 2.0	n, n′ + 0.13γ	graph		scin γ	56G15
	0.65	n, n′ + 0.13γ(90°)	**0.59**	*10*	scin γ	56V02
	1.2	n, n′ + 0.85γ(90°)	**0.15**	*6*	scin γ	56V02
	2.45	n, 1.47n′(90°)	**0.020**	*2*	pulsed	56C31
	2.45	n, 1.17n′(90°)	**0.011**	*1*	VdG	56C31
	2.45	n, 0.92n′(90°)	**0.012**	*2*		56C31
	2.50	n, 1.56n′	**0.4**		scin n	56B40
	2.50	n, 1.13n′	**0.3**		scin n	56B40
	2.50	n, 0.85n′	**0.1**		scin n	56B40
Zn	2.45	n, 1.37n′(90°)	**0.062**	*4*	pulsed VdG	56C31
	2.5	t-el	**1.30**		sphere	56B49
	7	t-el	**1.61**		sphere	56B49
	13.0 to 16.2	t	graph			56M51
$Zn^{(64)}$	12.5 to 17.5	n, 2n	graph		$38^{m}Zn$	56C22
Zn^{64}	14	n, p and n, np	**0.590**	*75*	ppl	56R29
$Zn^{(68)}$	14	n, α	**0.0082**	*16*	$2.6^{h}Ni$	56B50
As^{75}	2.45	n, 1.67n′(90°)	**0.027**	*6*	pulsed	56C31
	2.45	n, 1.20n′(90°)	**0.047**	*8*	VdG	56C31
	2.45	n, 0.82n′(90°)	**0.021**	*3*		
Se	1 to 10^3 ev	t	graph			55B115
	1 to 80kev	t	graph			56N07
	2.45	n, 1.79n′(90°)	**0.064**	*8*	pulsed	56C31
	2.45	n, 0.95n′(90°)	**0.043**	*5*	VdG	56C31

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
$Br^{(79)}$	14	n,α	**0.010**	2	26.5^{h}As	56B50
Kr	th	s coh	**7.4**	4	liquid mirror	56C30
Sr	6 to 102kev	t	**graph**			56N07
	~1	No n,n′γ	**<0.26**		scin γ	56V02
$Sr^{(84)}$	pile	n,γ	**1.6**	1	65^{d}Sr	56A16
$Sr^{(88)}$	12.5 to 17.5	n,p	**graph**		18^{m}Rb	56C22
Y^{89}	0.8 to 1.8	n,n′+0.91γ	**graph**		scin γ	55S92
Y^{90}	th	n,γ	**<6.5**		57^{d}Y	55S96
Zr	2 to 80kev	t	**graph**			56N07
	0.7 to 1.2	t	**graph**			56G05
	0.9 to 2.2	n,n′+0.93γ	**graph**		scin γ	56G05
	1.75 to 7	t-el	**table**		sphere	56B49
	2.45	n,1.52n′(90°)	**0.023**	2	pulsed VdG	56C31
	2.56	n,n′+2.17γ(90°)	**0.22**		scin γ	56D01
	2.56	n,n′+0.93γ(90°)	**0.05**		scin γ	56D01
$Zr^{(90)}$	14	n,α	**0.0033**	6	2.8^{h}Sr	55B136
Zr^{92+94}	1 to 5.5	n,n′+0.93γ	**graph**		scin γ	56G41
$Zr^{(94)}$	14	n,α	**0.0036**	5	9.7^{h}Sr	55B136
Nb^{93}	14	n,α	**0.0090**	22	64^{h}Y	56B50
Mo	1 to 80kev	t	**graph**			56N07
	2.45	n,1.62n′(90°)	**0.042**	4	pulsed VdG	56C31
	2.45	n,0.89n′(90°)	**0.052**	4		56C31
	4.4	el(90°)	**0.036**	9	ppl	56W02
	4.4	t(90°)	**0.076**	20		56W02
Mo^{98}	pile	n,γβ⁻	**0.13**		6.0^{h}Tc	56B65
Tc^{98}	pile	n,γ	**≤1**		6.0^{h}Tc	56B65
Tc^{99}	th	a	**19**	2	osc	55P49
	pile	n,n′	**~0.05**		6.0^{h}Tc	56B65
Ru^{99}	pile	n,p	**5×10^{-5} or (5×10^{-3})**		6.0^{h}Tc	56B65
Pd	14	t	**4.30**	10		56H42
$Pd^{(108)}$	14	n,α	**0.0023**	5	4.4^{h}Ru	56B50
Ag	2.5	t-el	**2.07**		sphere	56B49
	3.5 to 14.1	t-el	**table**		sphere	55T26
	7	t-el	**2.00**		sphere	56B49
	~12.5	t	**4.38**			56M51
	13.0 to 16.2	t	**graph**			56M51
Cd	~1 to 2000ev	t	**graph**			56P15
	1.2	t-el	**1.0**		sphere	56M63
	1.6	t-el	**1.3**		sphere	56M63
	1.75 to 7	t-el	**table**		sphere	56B49
	2.0	t-el	**1.7**		sphere	56M63
	2.45	n,1.81n′(90°)	**0.040**	5	pulsed VdG	56C31
	2.45	n,1.09n′(90°)	**0.031**	4		56C31
	2.45	n,0.96n′(90°)	**0.031**	4		56C31
	14	t	**4.37**	10		56H42
	55	t-el	**1.55**	2	"sphere"	56V11
	81	t-el	**1.25**	5	"sphere"	56V11
	105	t-el	**1.20**	3	"sphere"	56V11
	140	t-el	**1.07**	2	"sphere"	56V11

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
In	14	el(θ)	**graph**		scin n	56E03
$In^{(115)}$	14	n,α	**0.0020**	4	3.2^{h}Ag	56B50
Sn	1.75 to 7	t-el	**table**		sphere	56B49
	2.45	n,1.21n′(90°)	**0.047**	3	pulsed VdG	56C31
	3.5 to 14.1	t-el	**table**		sphere	55T26
	13.0 to 16.2	t	**graph**			56M51
	14.0	t	**4.70**			56M51
Fe	1 to 120kev	t	**graph**			56G32
	1.2	t-el	**0.5**		sphere	56M63
	1.6	t-el	**0.7**		sphere	56M63
	2.0	t-el	**1.0**		sphere	56M63
	1.67	el/inel (45°) =	**2.7**	2	scin n	55B137
	1.67	el/inel (90°) =	**0.7**	1	scin n	55B137
	1.67	el/inel(135°) =	**1.6**	2	scin n	55B137
	1.75 to 7	t-el	**table**		sphere	56B49
	2.56	n,n′+2.18γ(95°)	**0.0004**	1	scin γ	56D23
	2.56	n,n′+2.3γ (95°)	**0.0002**	1	scin γ	56D23
	3.5 to 14.1	t-el	**table**		sphere	55T26
	3.7 to 5.0	n,n′+0.84γ(100°)	**graph**		scin γ	56M54
	3.7	n,n′+1.25γ(100°)	**0.024**	5	scin γ	56M54
	3.7	n,n′+1.80γ(100°)	**0.025**	5	scin γ	56M54
	3.7	n,n′+2.06γ(100°)	**0.030**	6	scin γ	56M54
	3.7	n,n′+2.57γ(100°)	**0.007**	1	scin γ	56M54
	3.7	n,n′+3.07γ(100°)	**0.014**	3	scin γ	56M54
	3.7	n,n′+3.44γ(100°)	**0.021**	4	scin γ	56M54
	3.7	n,n′+0.84γ(90°)	**0.135**		scin γ	55R38
	3.7	n,n′+1.80γ(90°)	**0.024**		scin γ	55R38
	6.5	el(90°)	**0.013**	3	ppl	56W02
	6.5	t(90°)	**0.061**	17		56W02
	13.0 to 16.2	t	**graph**			56M51
	14	el(θ)	**graph**		scin n	56E03
$Fe^{(54)}$	2.56	n,n′+1.41γ(95°)	**0.064**	7	scin γ	56D23
$Fe^{(56)}$	0.8 to 1.8	n,n′+0.84γ(90°)	**graph**		scin γ	56V02
	1 to 5.5	n,n′+0.84γ	**graph**		scin γ	56G41
	2.45	n,1.61n′(90°)	**0.085**	3	pulsed VdG	56C31
	2.56	n,n′+0.84γ(95°)	**0.074**	6	scin γ	56D23
	2.56	n,n′+1.24γ(95°)	**0.0037**	5	scin γ	56D23
$Fe^{(57)}$	2.56	n,n′+0.12γ(95°)	**0.043**	7	scin γ	56D23
Co^{59}	2.45	n,1.25n′(90°)	**0.038**	5		56C31
	2.45	n,0.94n′(90°)	**0.034**	4	pulsed VdG	56C31
	2.45	n,0.70n′(90°)	**0.012**	2		56C31
	14	n,α	**0.031**	3	2.6^{h}Mn	56B50
Ni	2.45	n,1.1n′(90°), n,0.9n′(90°)	**0.052**	3	scin n	56C31
	3.5 to 14.1	t-el	**table**		sphere	55T26
	13.0 to 16.2	t	**graph**			56M51
$Ni^{(58)}$	pile	n,p	**0.030**	3	72^{d}Co	56R01
	2.56	n,n′+1.45γ(95°)	**0.045**	4	scin γ	56D23
$Ni^{(60)}$	pile	n,p	**<0.6**	1 mb	5.2^{y}Co	56R01
	2.56	n,n′+0.85γ(95°)	**0.017**	3	scin γ	56D23
	2.56	n,n′+1.33γ(95°)	**0.055**	6	scin γ	56D23
	2.56	n,n′+2.18γ(95°)	**0.005**	2	scin γ	56D23

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
Cu	th	a	3.78	5	osc	56B80
	1.2	t-el	0.5		sphere	56M63
	1.6	t-el	0.7		sphere	56M63
	2.0	t-el	1.1		sphere	56M63
	2.45	n, 1.47n′(90°)	0.038	5	pulsed VdG	56C31
	2.45	n, 0.99n′(90°)	0.032	4		56C31
	2.45	n, 0.83n′(90°)	0.013	3		56C31
	2.45	n, 0.71n′(90°)	0.009	2		56C31
	2.45	n, 0.55n′(90°)	0.007	2		56C31
	2.56	n,n′ + 0.76γ(95°)	0.004	1	scin γ	56D23
	2.56	n,n′ + 2.07γ(95°)	0.0029	6	scin γ	56D23
	3.5 to 14.1	t-el	table		sphere	55T26
	13.0 to 16.2	t	graph			56M51
	55	t-el	1.12	1	"sphere"	56V11
	81	t-el	0.84	4	"sphere"	56V11
	105	t-el	0.77	1	"sphere"	56V11
	140	t-el	0.74	1	"sphere"	56V11
	380	t	1.17	3		55D46
	500	t	1.21	2		55D46
	590	t	1.25	4		55D46
	630	t	1.31	3		55D46
$Cu^{(63)}$	2.56	n,n′ + 0.68γ(95°)	0.082	2	scin γ	56D23
	2.56	n,n′ + 0.97γ(95°)	0.042	5	scin γ	56D23
	2.56	n,n′ + 1.33γ(95°)	0.013	2	scin γ	56D23
	2.56	n,n′ + 1.41γ(95°)	0.007	2	scin γ	56D23
	2.56	n,n′ + 1.55γ(95°)	0.006	1	scin γ	56D23
	2.56	n,n′ + 1.88γ(95°)	0.003	1	scin γ	56D23
	2.56	n,n′ + 2.52γ(95°)	<0.0003		scin γ	56D23
	12.5 to 17.5	n,2n	graph		$10^{m}Cu$	56C22
$Cu^{(65)}$	2.56	n,n′ + 0.37γ(95°)	0.012	2	scin γ	56D23
	2.56	n,n′ + 1.11γ(95°)	0.043	5	scin γ	56D23
	2.56	n,n′ + 1.5γ (95°)	0.008	4	scin γ	56D23
	380	t	1.88	4		55D46
	500	t	1.93	3		55D46
	590	t	1.98	4		55D46
	630	t	2.03	4		55D46
Sb	3.7	n,n′ + 1.00γ(90°)	0.075		scin γ	55R38
Te	2.45	n, 1.73n′(90°)	0.055	6	pulsed VdG	56C31
I^{127}	~25 kev	n,γ	0.82	6	$25^{m}I$	56M33
	0.1 to 1.2	n,n′ + 0.06γ	graph		scin γ	56G15
	0.40	n,n′ + 0.06γ	0.30	5	scin γ	56V02
	0.65	n,n′ + 0.21γ	0.31	8	scin γ	56V02
	1.18	n,n′ + 0.43γ	0.44	12	scin γ	56V02
	1.18	n,n′ + 0.63γ	0.59	10	scin γ	56V02
I^{129}	pile	n,γ	35		$12.5^{h}I$	56P25
Xe	th	s coh	3.3	2	liquid mirror	56C30
Xe^{135}	0.015 to 0.2ev	t	graph			56B86
	pile	n,γ	2.58×10^{6}	20		
			$9.2^{h}Xe$ depletion			56F19
Cs^{133}	14	n,α	0.0010	3	$12.5^{h}I$	56B50
Ba	15 to 102kev	t	graph			56N07
$Ba^{(132)}$	pile	n,p	0.7	2 mb	$6.2^{d}Cs$	56R01

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
$Ba^{(136)}$	pile	n,p	0.20	5 mb	$13^{d}Cs$	56R01
Ba^{137}	0.5 to 3.0	n,n′ + 0.66γ	graph		scin γ	55S92
Ce	5 to 55kev	t	graph			56N07
Ce^{136}	pile	n,γ	6.3		$8.7^{h}Ce$	56B93
	pile	n,γ	0.6		$34.5^{h}Ce$	56B93
Ce^{138}	pile	n,γ	0.007^{+7}_{-3}		$55^{s}Ce$	56K23
	pile	n,γ	$\sim 1^{+1}_{-0.5}$		$140^{d}Ce$	56K23
$Ce^{(142)}$	pile	n,γ	0.95	5	$14^{d}Pr$	56R36
$Ce^{(143)}$	pile	n,γ	6.0	7	$17.5^{m}Pr$	56R25
Pr^{142}	th	n,γ	18	3	$14^{d}Pr$	55S96
Nd	14	t	5.08	10		56H42
Sm	14	t	5.12	10		56H42
Tm^{169}	0.0253ev	t	134	3		56E08
Hf	0.5 to 7.0ev	t	graph			56I01
	0.3 to 2.0	n,n′ + ~0.23γ	graph		scin γ	56G15
	14	t	5.44	10		56H42
Ta^{181}	0.1 to 1.8	n,n′ + 0.14γ	graph		scin γ	56G15
	2.56	n,n′ + 0.14γ(95°)	0.036	5	scin γ	56D23
	2.56	n,n′ + 0.16γ(95°)	0.019	3	scin γ	56D23
	2.56	n,n′ + 0.35γ(95°)	0.011	3	scin γ	56D23
	2.56	n,n′ + 0.48γ(95°)	0.068	9	scin γ	56D23
	14	t	4.96	10		56H42
	14	el(θ)	graph		scin n	56E03
	14.1	n(5 to 12 Mev)n′	0.20		ppl	56A15
W	0.3 to 1.8	n,n′ + ~0.12γ	graph		scin γ	56G15
	380	t	2.69	4		55D46
	500	t	2.73	3		55D46
	590	t	2.78	6		55D46
	630	t	2.82	5		55D46
Re	1.0 to 2.5ev	t	graphs			55I09
	0.1 to 1.9	n,n′ + ~0.13γ	graph		scin γ	56G15
Ir	0.5 to 6.2	t	graphs			55L55
Pt	0.3 to 1.8	n,n′ + ~0.33γ	graph		scin γ	56G15
Au^{197}	0.0253ev	a	99.3	5	1/v line	56H07
	0.0253ev	a	99.0	20	1/v line	55G64
	0.3 to 1.6	n,n′ + ~0.28γ	graph		scin γ	56G15
	1.75 to 7	t-el	table		sphere	56B49
	14	n, >7Mev p	~0.11		ppl	56P02
	14	n, ~13Mev p	0.04		ppl	56P02
Au^{198}	th	n,γ	26×10^{3}	1	$3.16^{d}Au$	55B142
	pile	n,γ	26×10^{3}	1	S	55B101
Au^{199}	th	n,γ	$<3 \times 10^{3}$		$48^{m}Au$	55B142
Hg	13.0 to 16.2	t	graph			56M51
	15.7	t	5.50			56M51
Hg^{199}	0.6 to 1.0	n,n′ + 44^{m}Hg	graph		scin γ	55S92

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
Pb	2 to 80kev	t	graph			56N07
	1.2	t-el	0.4		sphere	56M63
	1.6	t-el	0.6		sphere	56M63
	2.0	t-el	1.0		sphere	56M63
	3.4	el(θ)	graph		scin n	55B110
	3.5 to 14.1	t-el	table		sphere	55T26
	10	t-el	2.58		sphere	56B79
	13.0 to 16.2	t	graph			56M51
	15.4	t	5.58			56M51
	55	t-el	2.34	2	"sphere"	56V11
	81	t-el	2.00	3	"sphere"	56V11
	105	t-el	1.72	4	"sphere"	56V11
	140	t-el	1.70	2	"sphere"	56V11
	380	t	2.81	5		55D46
	500	t	2.85	3		55D46
	590	t	2.92	7		55D46
	630	t	2.94	7		55D46
$Pb^{(206)}$	2.45	n,1.65n′(90°)	0.051	6	pulsed	56C31
	2.45	n,1.01n′(90°)	0.044	6	VdG	56C31
	2.45	n,0.72n′(90°)	0.032	5		56C31
	2.56	n,n′+0.53γ(95°)	0.046	7	scin γ	56D23
	2.56	n,n′+0.66γ(95°)	0.022	7	scin γ	56D23
	2.56	n,n′+0.80γ(95°)	0.112	12	scin γ	56D23
	2.56	n,n′+1.44γ(95°)	0.010	5	scin γ	56D23
	2.56	n,n′+1.73γ(95°)	0.015	6	scin γ	56D23
$Pb^{(207)}$	2.56	n,n′+0.57γ(95°)	0.077	14	scin γ	56D23
	2.56	n,n′+0.89γ(95°)	0.051	7	scin γ	56D23
Bi^{209}	2ev to 0.02	t	graph			55B115
	1 to 50kev	t	graph			56G32
	1.75 to 7	t-el	table		sphere	56B49
	2.45	n,1.52n′(90°)	0.030	3	pulsed	56C31
	2.45	n,0.83n′(90°)	0.034	4	VdG	56C31
	2.56	n,n′+0.93γ(95°)	0.034	4	scin γ	56D23
	2.56	n,n′+1.62γ(95°)	0.021	2	scin γ	56D23
	3.4	el(θ)	graph		scin n	55B110
	3.5 to 14.1	t-el	table		sphere	55T26
	10	t-el	2.52		sphere	56B79
	13.0 to 16.2	t	graph			56M51
	14	el(θ)	graph		scin n	56E03
	15.9	t	5.75			56M51
Ra^{223}	th	n,γ	125	15	$11^{h}Pb$	55H71
Ac^{227}	th	a	510	36	osc	56K16
Pa^{231}	th	n,γ	200	15	$1.3^{d}Pa$	56S25
Pa^{232}	pile	n,γ	760	100	$27^{d}Pa$	56S25
Pa^{233}	pile	n,γ	140	20	ms	56H14
U	0.3 to 1.2ev	t	graph			55A51
	0.5 to 1.0	t-el	table		sphere	56B82
	1.0 to 1.8	f	graph			55S100
	380	t	3.25	6		55D46
	500	t	3.27	5		55D46
	590	t	3.29	7		55D46
	630	t	3.30	8		55D46

Neutron Cross Sections continued

Target	Neutron Energy	Type of σ	Value of σ or ∫σdΩ		Method	Ref.
U^{233}	0.002 to 1000ev	f	graph			55A51
	0.0044, 0.0118	a	table		sphere	56M40
	0.8 to 3.2	f	graph			56N10
	0.85	f	1.92	25		55S100
U^{234}	0.30 to 4.0	f	graph			55L50
U^{235}	0.004 to 200ev	f	graph			55A51
	0.005 to 150ev	f(rel)	graph			55P48
	4.4 to 49kev	a	graph		sphere	56M53
	0.4 to 1.6	f	graph			53D41
	0.70 to 1.0	f	1.15	15		55S100
	1.25	f	1.27	4		53D41
U^{236}	0.67 to 4.0	f	graph			55L50
U^{238}	29 to 840kev	n,γ	table		$23.5^{m}U$	55R55
	2.45	n,1.27n′(90°)	0.010	3	pulsed VdG	56C31
Np^{237}	th	n,γ	172	7	$90^{y}Pu$	56B28
Np^{239}	pile	n,γ	80	15	ms	56H31
	pile	n,γ	17	$^{+17}_{-6}$	$1^{h}Np$	56L01
	pile	n,γ	29	6	$7.3^{m}Np$	56L01
Pu^{238}	th	n,γ	454	8	ms	56B26
	pile	n,γ	484	7	ms	56B26
Pu^{239}	10^{-3} to 100ev	f	graph			55A51
	0.007 to 700ev	f(rel)	graph			56R12
	0.01 to 2ev	t	graph			55G63
	0.0253ev	t	1050	13		55A47
	0.0253ev	t	1015	30		56P10
	pile	n,γ	400	40	ms	56H31
	4.4 to 49kev	a	graph		sphere	56M53
	0.05 to 2.0	f	graph			55S100
	0.8 to 3.2	f	graph			56N10
Pu^{240}	th	f	4.4	5		56H37
	pile	n,γ	530	50	ms	56F05
Pu^{241}	0.01 to 8ev	f(rel)	graph			56R12
	th	a	1450	250	ms	56F05
	th	f	1060	210		56F05
Pu^{242}	th	n,γ	22.9	8	$Am^{243}\alpha$	56B26
	pile	n,γ	50.6	7	$Am^{243}\alpha$	56B26
	pile	t	64	15	ms	56B26
	pile	n,γ	30	10	ms	56F05
Pu^{243}	pile	n,γ	170	90	ms	56F05
Pu^{244}	pile	n,γ	1.5	3	$10^{h}Pu$	56F05
	pile	n,γ	2.1	3	$2.0^{h}Am$	56B92
	pile	n,γ	1.4		$2.0^{h}Am$	55F37
Pu^{245}	pile	n,γ	260	145	$25^{m}Am$	56F05
Am^{243}	th	n,γ	81.6	18	$Cm^{244}\alpha$	56B26
	pile	n,γ	131.8	17	$Cm^{244}\alpha$	56B26
Cm^{245}	th	f	1800	300		56F11
E^{253}	pile	n,γ	450		$3.2^{h}Fm$	56J09

53D41 B.C.Diven, LA-1336 (1953); compared with neutron-proton scattering cross sections.

55A47 Y.G.Abov. Conf. Acad. Sci. USSR on Peaceful Uses of Atomic Energy, Phys. Math. Sci. p.249, July (1955); Consultants Bureau Trans. p.209.

55A51 J.M.Auclair, M.Galula, P.Hubert, P.Jacrot, R.Joly, F.Netter, G.Vendryes, Geneva Conf. 8/P/354 (1955).

55B101 R.E.Bedford, A.M.Crooker, Can. J. Phys. 33, 25, 492 Errata (1955); Proc. Roy. Soc. Canada 48, 27A (1954); from Hg^{198} and Hg^{199} atomic spectra. Corrected value previously given (see N.S.A. 9, 24B reference 54B99 -Au^{198} heading was accidentally omitted) for finite irradiation time and Hg^{199} burnout.

55B110 H.R.Brugger, H.J.Gerber, B.Lüthy, A.E.Remund, Helv. Phys. Acta 28, 331A (1955).

55B115 L.M.Bollinger, D.A.Dahlberg, R.R.Palmer, G.E. Thomas, Phys. Rev. 100, 126 (1955).

55B136 H.G.Blosser, C.D.Goodman, T.H.Handley, M.L. Randolf, Phys. Rev. 100, 429 (1955); based on $\sigma(n,p)Fe^{56} = 0.110$.

55B137 S.D.Bloom, G.N.Glasoe, C.O.Muehlhause, H.E. Wegner, Phys. Rev. 100, 1248A (1955); verbal report.

55B142 R.E.Bell, R.L.Graham, L.Yaffe, Can. J. Phys. 33, 457; Phys. Rev. 99, 1646A (1955); based on $\sigma_a(Au^{197}) = 99$; same data as N.S.A. 9, 24B reference 55G29, Au^{198} heading was accidentally omitted.

55B146 R.Batchelor, R.Aves, T.H.R.Skyrme, Rev. Sci. Instr. 26, 1037 (1955).

55D46 V.P.Džhelepov, V.I.Satarov, B.M.Golovin, Doklady Akad Nauk SSSR 104, 717 UCRL Trans. 257; Zhur Eksptl' i Teoret Fiz. 29, 369 (1955); Soviet Physics, JETP 2, 349 (1956).

55F37 P.R.Fields, M.H.Studier, A.M.Friedman, H.Diamond, R.Sjoblom, P.A.Sellers, J. Inorg. Nuclear Chem. 1, 262 (1955). (Correction to N.S.A. 10, 12B.)

55G63 N.D.Galanina, K.Ignatyev, S.Nikitin, S.Sukhoruchkin, quoted by Y.G.Abov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p.249, July (1955); Consultants Bureau Trans. p.209.

55G64 F.T.Gould, T.I.Taylor, W.W.Havens,Jr., Phys. Rev. 100, 1243A (1955); resonance contribution included.

55H55 J.Halperin, R.W.Stoughton, D.E.Ferguson, C.V. Ellison, D.C.Overholt, C.M.Stevens, Geneva Conf. 8/P/732 (1955); based on $\sigma_a(U^{238}) = 2.80$.

55H71 G.Harbottle, J. Inorg. Nuclear Chem. 1, 253 (1955); based on $\sigma_a(Co) = 35$.

55I09 G.Igo, Phys. Rev. 100, 1338; 99, 610A (1955).

55L50 R.W.Lamphere, R.E.Greene, Phys. Rev. 100, 763 (1955).

55L55 H.H.Landon, Phys. Rev. 100, 1414; 99, 610A (1955); 92, 656 (1953).

55M86 J.B.Marion, R.M.Brugger, Phys. Rev. 100, 69 (1955).

55P48 B.T.Price, J. Nuclear Energy 2, 128 (1955).

55P49 H.Pomerance ORNL-1975 (1955); used $\sigma_a(Au^{197}) = 98$.

55R38 M.A.Rothman, H.S.Hans. C.E.Mandeville, Phys. Rev. 100, 83 (1955).

55R55 B.Rose, AERE-NP/R-1743 (1955).

55S92 C.P.Swann, F.R.Metzger, Phys. Rev. 100, 1329 (1955).

55S96 R.R.Smith, S.D.Reeder, J. Chem. Phys. 23, 2108 (1955); based on $\sigma_a(Co) = 34$.

55S100 D.Szteinsznaider, V.Naggiar, F.Netter, Geneva Conf. 8/P/355 (1955); based on $\sigma_f(U) = 2.04$.

55T26 H.L.Taylor, O.Lönsjö, T.W.Bonner, Phys. Rev. 100, 174 (1955).

56A15 A.H.Armstrong, L.Rosen, L.Stewart, Bull. Am. Phys. Soc. 1, No. 6, 296 R2 (1956).

56A16 M.Asdente, A.Bissi, E.Germagnoli, L.Zappa, Nuclear Phys. 1, 420 (1956); based on $\sigma_a(Sr^{88}) = 0.005 \pm 1$ and observed $\sigma_a(Sr^{84})/\sigma_a(Sr^{88}) = 318 \pm 21$.

56A21 A.H.Armstrong, G.M.Frye,Jr., Phys. Rev. 103, 335 (1956); 98, 241A (1955).

56B26 J.P.Butler, M.Lounsbury, J.Merritt, CRC 628 (1956); based on $\sigma_a(Co) = 36.4$.

56B28 F.Brown, G.R.Hall, J. Inorg. Nuclear Chem. 2, 205 (1956); AERE C/R 1799 (1955); used $\sigma_a(Au^{197}) = 98$.

56B35 R.M.Brugger, J.E.Evans, E.G.Joki, R.S. Shankland, Bull. Am. Phys. Soc. 1, No. 4, 176 F11 (1956).

56B40 L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

56B49 J.R.Beyster, M.Walt, Bull. Am. Phys. Soc. 1, No. 4, 176 F9 (1956).

56B50 H.G.Blosser, T.R.Handley, C.D.Goodman, Bull. Am. Phys. Soc. 1, No. 4, 224 W6 (1956); verbal report; Phys. Rev. 100, 429 (1955); based on $\sigma_{n,p}(Fe^{56}) = 0.110$.

56B62 R.L.Becker, H.H.Barshall, Phys. Rev. 102, 1384 (1956).

56B80 R.A.Bennett, D.J.Donahue, D.D.Lanning, Bull. Am. Phys. Soc. 1, No. 5, 248 C11; No. 7 358E (1956); used $\sigma_a(Au^{197}) = 99.0 \pm 2$.

56B82 R.Batchelor, Proc. Phys. Soc. 69A, 214 (1956).

56B86 S.Bernstein, M.M.Shapiro, C.P.Stanford, T.E. Stephenson, J.B.Dial, S.Freed, G.W.Parker, A.R.Brosi, G.M.Hebert, T.W.DeWitt, Phys. Rev. 102, 823 (1956).

56B65 G.E.Boyd, Q.V.Larson, J. Phys. Chem. 60, 707 (1956).

56B92 J.P.Butler, T.A.Eastwood, T.L.Collins, M.E. Jones, F.M.Rourke, R.P.Schuman, Phys. Rev. 103, 917 (1956); Bull. Am. Phys. Soc. 1, No. 4, 187 K4 (1956).

56B93 A.R.Brosi, B.H.Ketelle, Phys. Rev. 103, 917 (1956).

56C04 P.J.Campion, G.A.Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28 GA2 (1956); verbal report.

56C22 A.V.Cohen, P.H.White, Nuclear Phys. 1, 73 (1956).

56C30 M.F.Crouch, V.E.Krohn, G.R.Ringo, Phys. Rev. 102, 1321 (1956); using σ_s coh = $4\pi a^2$.

56C31 L.Cranberg, J.S.Levin, Phys. Rev. 103, 343 (1956); Bull. Am. Phys. Soc. 1, No. 1, 56 R10 (1956); verbal report.

56C44 L.Cranberg, LA-1853 (1956).

56C45 C.H.Collie, R.E.Meads, E.E.Lockett, Proc. Phys. Soc. 69A 464 (1956).

56D01 R.B.Day, A.E.Johnsrud, D.A.Lind, Bull. Am. Phys. Soc. 1, No. 1, 56 R9 (1956); verbal report.

56D23 R.B.Day, Phys. Rev. 102, 767 (1956).

56E03 J.O.Elliot, Phys. Rev. 101, 684 (1956).

56E08 J.E.Evans, E.G.Joki, Bull. Am. Phys. Soc. 1, No. 6, 281 B7 (1956).

56F05 P.R.Fields, G.L.Pyle, M.G.Inghram, H.Diamond, M.H.Studier, W.M.Manning, Nuclear Sci. Eng. 1, 62 (1956); Geneva Conf. 8/P/809; based on effective $\sigma_a(Pu^{239}) = 1150$ and $\sigma_{n,\gamma}(Pu^{239}) = 385$; σ's for Pu^{244} and Pu^{245} based on $\sigma_a(Au^{197}) = 98$.

56F11 P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

56F18 G.M.Frye,Jr., J.H.Gammel, Phys. Rev. 103, 328 (1956).

56F19 M.S.Freedman, A.Turkevich, R.M.Adams, N.Sugarman, S.Raynor, L.S.Stang,Jr., J. Inorg. Nuclear Chem. 2, 271 (1956); σ for mean neutron temperature of 400°K.

56G05 J.B.Guernsey, C.Goodman, Phys. Rev. 101, 294 (1956).

56G15 J.B.Guernsey, A.Wattenberg, Phys. Rev. 101, 1516 (1956).

56G32 J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

56G41 G.L.Griffith, Phys. Rev. 103, 643 (1956); $\sigma = 4\pi\sigma(90°)$ is tabulated in paper.

56H01 R.K.Haling, Bull. Am. Phys. Soc. 1, No. 1, 29 GA9 (1956); verbal report.

56H07 N.Holt, B.M.Rustad, F.Gould, Bull. Am. Phys. Soc. 1, No. 1, 70 Y4 (1956); resonance contribution included; verbal report.

56H08 D.G.Henshaw, Bull. Am. Phys. Soc. 1, No. 1, 63 UA10 (1956); verbal report.

56H14 J.Halperin, R.W.Stoughton, C.V.Ellison, D.E. Ferguson, Nuclear Sci. Eng. 1, 1 (1956); based on $\sigma_a(Th^{232}) = 8.0$.

56H15 H.E.Hall, T.W.Bonner, Bull. Am. Phys. Soc. 1, No. 2, 96 N10 (1956).

56H31 J.Halperin, R.W.Stoughton, C.M.Stevens, D.E. Ferguson, D.C.Overholt, Nuclear Sci. Eng. 1, 108 (1956); based on $\sigma_{n,\gamma}(U^{238}) = 3.5$ and $\sigma_{n,\gamma}(U^{239}) = 50$. Studier, et al. in ANL 4667 (1951) report $\sigma_{n,\gamma}(U^{239}) = 22$, but Halperin et al. have increased this to take into account the large resonance absorption in U^{238}. This paper replaces the work of 55H55 on Pu, which was accidentally reported under Pu^{240} instead of Pu^{239} in NSA 10-12B.

56H37 E.K.Hulet, H.R.Bowman, M.C.Michael, R.W.Hoff, Phys. Rev. 102, 1621 (1956); based on $\sigma_f(Pu^{239}) = 750$.

56H42 J.Haugsnes, Bull. Am. Phys. Soc. 1, No. 4, 187 K2 (1956).

56I01 G.Igo, H.H.Landon, Phys. Rev. 101, 726 (1956).

56J09 M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

56K16 H.W.Kirby, G.R.Grove, D.L.Timma, Phys. Rev. 102, 1140 (1956); from 1952 value of Pomerance ($\sigma_a = 500$) corrected for more accurate weight of sample and for $\sigma_a(Au^{197}) = 98$ instead of 95.

56K23 B.H.Ketelle, H.Thomas, A.R.Brosi, Phys. Rev. 103, 190 (1956); for 140^dCe, used $\sigma_a(Ce^{141}) = 0.6$; for 55^sCe, $\sigma_a(Ce^{136}) = 6.3$ for the production of the 8.7^hCe.

56L01 H.W.Lefevre, E.M.Kinderman, H.H. Van Tuyl, Bull. Am. Phys. Soc. 1, No. 1, 62 UA6 (1956).

56L06 W.S.Lyon, N.H.Lazar, Phys. Rev. 101, 1524 (1956); based on $\sigma_a(Mn^{55}) = 13.4$.

56M06 J.B.Marion, R.M.Brugger, R.A.Chapman, Phys. Rev. 101, 247 (1956).

56M07 R.L.Macklin, H.W.Schmitt, J.H.Gibbons, Bull. Am. Phys. Soc. 1, No. 1, 62 UA7 (1956).

56M33 R.L.Macklin, Bull. Am. Phys. Soc. 1, No. 5, 264 F5 (1956); verbal report.

56M40 R.L.Macklin, H.W.Schmitt, J.H.Gibbons, ORNL-2022 (1956).

56M51 M.Mazari, F.Alba, V.Serment, Anales Inst Fis. Mexico, 1, 69 (1956); Phys. Rev. 100, 927A (1955); σ_t(max) between 13 to 16 Mev.

56M53 R.L.Macklin, H.W.Schmitt, J.H.Gibbons, Phys. Rev. 797 (1956); ORNL-2022 (1956); Bull. Am. Phys. Soc. 1, No. 1, 62 UA7 (1956).

56M54 I.L.Morgan, Phys. Rev. 103, 1031 (1956).

56M62 R.E.Meads, C.J.England, C.H.Collie, G.C.Weeks, Proc. Phys. Soc. 69A, 469 (1956); replaces data incorrectly referred to as 55C42 in NSA No. 9, 24B, that reference should have read 55C41; C.H. Collie, R.E.Meads, quoted by Allen, Egelstoff, Nature 175, 1027 (1955).

56M63 G.C.Morrison, Amsterdam Conf. Nuclear Reactions, July 1956, verbal report.

56N07 H.W.Newson, J.H.Gibbons, H.Marshak, R.M. Williams, R.A.Mobley, A.L.Toller, R.Block, Phys. Rev. 102, 1580 (1956).

56N10 F.Netter, J.Julien, C.Gorge, R.Ballini, J. Phys. radium 17, 565 (1956); Pu^{239} curve normalized to 2.04b at 1.6 Mev; U^{233} curve "normalized" to value for thermal neutrons.

56P02 R.A.Peck,Jr., Bull. Am. Phys. Soc. 1, No. 1, 40 JA8 (1956); verbal report.

56P10 N.J.Pattenden, J. Nuclear Energy 2, 187, 300 Errata (1956); Geneva Conf. 8/P/422. The value reported at Geneva and in the paper is 1050 ± 30. The errata note corrects this to 1015 ± 30.

56P15 R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

56P25 B.C.Purkayastha, G.R.Martin, Can. J. Chem. 34, 293 (1956); based on $\sigma_a(Cu^{63}) = 4.24$.

56R01 B.L.Robinson, R.W.Fink, Bull. Am. Phys. Soc. 1, No. 1, 40 JA7 (1956).

56R12 R.Richmond, B.T.Price, J. Nuclear Energy, 2, 177 (1956).

56R25 L.P.Roy, L.Yaffe, Can. J. Chem. 34, 238 (1956); used $\sigma_a(Co^{59}) = 36.3$, $\sigma_a(Ce^{142}) = 0.95$.

56R29 L.Rosen, A.H.Armstrong, Bull. Am. Phys. Soc. 1, No. 4, 224 W7 (1956).

56R34 F.L.Ribe, Phys. Rev. 103, 741 (1956).

56R36 L.P.Roy, L.Yaffe, Can. J. Chem. 34, 1023 (1956); used $\sigma_a(Co^{59}) = 36.3$.

56S25 R.R.Smith, N.P.Alley, R.H.Lewis, A.VanderDoes, Phys. Rev. 101, 1053 (1956); based on $\sigma_a(Co^{59}) = 37.0$.

56T01 A.Taylor, H.Marshak, H.W.Newson, Bull. Am. Phys. Soc. 1, No. 1, 62 UA3 (1956); verbal report.

56V02 J.J. Van Loef, D.A.Lind, Phys. Rev. 101, 103 (1956); assumed isotropic distribution for I.

56V11 R.G.P.Voss, R.Wilson, Proc. Roy. Soc. 236A, 41 (1956); Diameter of liquid scintillator and absorber $\gg$ diameter of beam; used σ_t(C) of Taylor and Wood, Phil. Mag. 44, 95 (1953) to determine energy of neutron beam.

56W02 J.B.Weddell, B.Jennings, Bull. Am. Phys. Soc. 1, No. 1, 55 R5 (1956); verbal report.

56W04 H.B.Willard, J.K.Bair, J.D.Kington, H.O.Cohn, Phys. Rev. 101, No. 2, 765 (1956).

3. GROUND STATE Q'S

Q values are defined by the conservation equation, $M_1 + M_2 = M_3 + M_4 + Q$ or $Q = E_3 + E_4 - E_1 - E_2$, where the M's are the rest masses and the E's the kinetic energies of the reacting particles. Ground state Q's are those measured when the product particles are left in their lowest energy states. If the most energetic emitted particle has escaped detection, the true ground state Q is greater than the value given.

The energy standard used, when clearly stated by the experimenter, is mentioned with the reference. Usually the energy measurement for only one particle, either the incident or emitted light particle, presents difficulties. It is the standard used for this particle that is given.

N. B. A uniform policy for denoting the use of enriched or monoisotopic material is now in use in all New Nuclear Data tables. This policy is described in the section on Conventions just following the Introduction. Briefly, parentheses around the A value indicate natural material, no parentheses enriched or monoisotopic material.

Reaction	Value		Source	Detector	Ref.
$Li^6(p,\gamma)Be^7$	5.66	5	VdG	scin	56W03
$Li^{(7)}(d,p)Li^{(8)}$	−0.183	20		s	55K41
$Li^{(7)}(d,\alpha)He^{(5)}$	13.719	20		s	55K41
$Li^{(7)}(t,\alpha)He^{(6)}$	9.79	14	VdG	ppl	56B106
$Li^7(\alpha,n)B^{10}$	−2.82	10	cyc	BF_3pc	56R06
$Li^{(7)}(\alpha,n)B^{(10)}$	−2.79		VdG	thresh n	56B23
$Li^7(Li^7,p)B^{13}$	5.97	3	VdG	scin a	56A14
$Be^8 \rightarrow 2He^4$	0.091		B^{12}	s	56F10
$Be^9(p,n)B^9$	−1.853	3	VdG	thresh n	55M84
$B^{10}(p,\gamma)C^{11}$	8.81	10	VdG	scin	56C20
$B^{(10)}(d,t)B^{(9)}$	−2.187	10	VdG	s	56B52
$B^{10}(\alpha,p)C^{13}$	4.08	3	cyc	scin	56P06
$B^{10}(\alpha,p)C^{13}$	4.064	12	VdG		55F15
$B^{10}(\alpha,d)C^{12}$	1.341	2	VdG	EA	55C45
$B^{10}(\alpha,d)C^{12}$	1.36	9	cyc	scin	56P06
$B^{(11)}(p,n)C^{(11)}$	−2.83	$^{+8}_{-5}$	VdG	ppl	56A22
$B^{(11)}(\alpha,n)N^{(14)}$	0.0	3	cyc	p recoil	56Q01
$B^{11}(\alpha,p)C^{14}$	0.788	17	VdG		55F15
$C^{(12)}(t,p)C^{(14)}$	4.64	4	VdG	ppl	56B106
$C^{(12)}(He^3,n)O^{(14)}$	1.148	4	VdG	BF_3	56B22
$C^{(12)}(He^3,n)O^{(14)}$	1.148	3	VdG		56B37
$C^{(12)}(He^3,p)N^{(14)}$	4.77		VdG	ppl	56J02
$C^{14}(d,p)C^{15}$	−1.007	1	VdG	EA	55D34
$C^{14}(d,\alpha)B^{12}$	0.362	2	VdG	EA	55D34
$N^{(14)}(n,\gamma)N^{(15)}$	10.833	8	pile	sπ pr	56C04
$N^{(14)}(d,n)O^{(15)}$	5.21	7	VdG	ppl	56N04
$N^{(14)}(\alpha,n)F^{(17)}$	−4.76	7	cyc	66^sF	56D47
$O^{(16)}(d,n)F^{(17)}$	−1.626	4	VdG	thresh n	55M85
$O^{(16)}(d,\alpha)N^{(14)}$	3.108		VdG		55B147
$O^{(16)}(t,\alpha)N^{(15)}$	7.65	5	VdG	ppl	56B106
$O^{18}(p,n)F^{18}$	−2.447	10	VdG	BF_3	56M18
$O^{18}(d,\alpha)N^{16}$	4.237	9	CcW	sd	55P50

Reaction	Value		Source	Detector	Ref.
$F^{19}(n,\gamma)F^{20}$	6.599	11	pile	sπ pr	56C04
$F^{19}(n,d)O^{18}$	−5.79	8	(d,t)	pc	55R40
$F^{19}(p,n)Ne^{19}$	−4.022	5	VdG	thresh n	55M84
$F^{19}(d,p)F^{20}$	4.38	3	cyc	s	56E09
$F^{19}(t,\alpha)O^{18}$	11.847		VdG	sd	56J01
$F^{19}(\alpha,n)Na^{22}$	−2.052	6	VdG	thresh	56B51
$F^{19}(\alpha,n)Na^{22}$	−2.0	2	cyc	p recoil	56Q01
$F^{19}(\alpha,p)Ne^{22}$	1.673	11	VdG		55F15
$Na^{23}(\gamma,n)Na^{22}$	−12.46	8	βtron		56C48
$Na^{23}(\alpha,n)Al^{26}$	−2.970	6	VdG	thresh	56B51
$Na^{23}(\alpha,n)Al^{26}$	−2.9	2	cyc	p recoil	56D47
$Mg^{24}(\alpha,p)Al^{27}$	−1.63	7	cyc	pc	56G28
$Mg^{25}(p,\alpha)Na^{22}$	−3.15		VdG		55B147
$Mg^{(25)}(n,\gamma)Mg^{(26)}$	11.086	25	pile	sπ pr	56C04
$Mg^{25}(\alpha,p)Al^{28}$	−1.29		cyc	pc	56G28
$Mg^{26}(\alpha,p)Al^{29}$	−2.90		cyc	pc	56G28
$Al^{27}(\gamma,n)Al^{26}$	−12.93	8	βtron		56C48
$Al^{27}(p,n)Si^{27}$	−5.607	8	VdG	thresh n	55M84
$Al^{27}(d,p)Al^{28}$	5.502	10	VdG	s	56B13
$Al^{27}(\alpha,n)P^{30}$	−2.968	6	VdG	thresh	56B51
$Al^{27}(\alpha,p)Si^{30}$	2.38	3	cyc	ppl	56H34
$Si^{(28)}(d,p)Si^{(29)}$	6.229	40		s	54K47
$P^{31}(\gamma,n)P^{30}$	−12.45	8	βtron		56C48
$P^{31}(p,\alpha)Si^{28}$	1.911	5	VdG	sd	56V14
$P^{31}(\alpha,n)Cl^{34}$	−5.7	2	cyc	thresh n	56Q01
$P^{31}(\alpha,p)S^{34}$	0.7	1	cyc	scin	56S81
$S^{(32)}(d,\alpha)P^{(30)}$	4.831	13	VdG	s	56L14
$Cl^{(35)}(\gamma,n)Cl^{(34)}$	−12.35	3.5	βtron	32^mCl	54S107
$Cl^{(35)}(p,\alpha)S^{(32)}$	1.851	7	VdG	sd	55V14
$Cl^{(35)}(p,\alpha)S^{(32)}$	1.865	15	VdG	sπ	55A50
$Cl^{(35)}(p,\alpha)S^{(32)}$	1.863	8	VdG	s	56E12

Ground State Q's continued

Reaction	Value		Source	Detector	Ref.
$Cl^{(35)}(d,p)Cl^{(36)}$	6.354	8	VdG	s	55P46
$Cl^{(35)}(d,\alpha)S^{(33)}$	8.277	10	VdG	s	55P46
$Cl^{(37)}(p,\alpha)S^{(34)}$	3.015	15	VdG	sπ	55A50
$Cl^{(37)}(p,\alpha)S^{(34)}$	3.015	11	VdG	sd	55V14
$Cl^{(37)}(p,\alpha)S^{(34)}$	3.026	8	VdG	s	56E12
$Cl^{(37)}(d,p)Cl^{(38)}$	3.877	8	VdG	s	55P46
$Cl^{(37)}(d,\alpha)S^{(35)}$	7.783	12	VdG	s	55P46
$A^{36}(\alpha,p)K^{39}$	−1.28	3	cyc	ppl	56S20
$A^{40}(\alpha,p)K^{43}$	−3.36	3	cyc	ppl	56S20
$K^{(39)}(n,\alpha)Cl^{(36)}$	1.25	20	VdG	scin	56S57
$K^{(39)}(p,\alpha)A^{(36)}$	1.267	20	VdG	sπ	55A50
$K^{(41)}(p,\alpha)A^{(38)}$	4.002	15	VdG	sπ	55A50
$Ca^{(40)}(d,p)Ca^{(41)}$	6.140	9	VdG	sπ	56B109
$Ca^{40}(d,\alpha)K^{38}$	4.650	10	VdG	s	56B108
$Ca^{42}(p,\alpha)K^{39}$	0.118	7	VdG	s	56B108
$Ca^{42}(d,p)Ca^{43}$	5.711	10	VdG	s	56B108
$Ca^{43}(p,\alpha)K^{40}$	−0.014	8	VdG	s	56B108
$Ca^{43}(d,p)Ca^{44}$	8.913	14	VdG	s	56B108
$Ca^{44}(p,\alpha)K^{41}$	−1.057	10	VdG	s	56B108
$Ca^{44}(d,p)Ca^{45}$	5.188	10	VdG	s	56B108
$Ca^{48}(d,p)Ca^{49}$	3.916	6	VdG	s	56B108
$Sc^{45}(p,n)Ti^{45}$	−2.844	4	VdG	thresh n	55B116
$V^{(51)}(\gamma,n)V^{(50)}$	−11.09	11	βtron		56C48
$V^{(51)}(p,n)Cr^{(51)}$	−1.5355	15	VdG	BF_3	55G54
$V^{(51)}(p,n)Cr^{(51)}$	−1.535		VdG	n res	55M81
$V^{(51)}(p,\alpha)Ti^{(48)}$	1.161	10	VdG	s	55B127
$Cr^{52}(d,p)Cr^{53}$	5.74		cyc	pc	56E07
$Cr^{53}(d,p)Cr^{54}$	7.55		cyc	pc	56E07
$Mn^{55}(\gamma,n)Mn^{54}$	−10.13	7	βtron		56C48
$Mn^{55}(p,n)Fe^{55}$	−1.015	3	VdG	thresh n	56J12
$Fe^{54}(d,p)Fe^{55}$	7.073		VdG	s	56S31
$Fe^{56}(d,p)Fe^{57}$	5.418		VdG	s	56S31
$Fe^{57}(d,p)Fe^{58}$	7.808		VdG	s	56S31
$Fe^{58}(d,p)Fe^{59}$	4.350		VdG	s	56S31
$Co^{59}(\gamma,n)Co^{58}$	−10.39	6	βtron		56C48
$Ni^{58}(p,\gamma)Cu^{59}$	3.43	2	VdG	scin	56G03
$Ni^{60}(p,\gamma)Cu^{61}$	4.88		VdG	scin	56G03
$Cu^{(63)}(\gamma,n)Cu^{(62)}$	−10.80	5	βtron	10^mCu	56B47
$Cu^{(63)}(\gamma,n)Cu^{(62)}$	−10.73	3	βtron		56R38
$Cu^{63}(p,n)Zn^{63}$	−4.149	4	VdG	thresh n	55B116

Ground State Q's continued

Reaction	Value		Source	Detector	Ref.
$Cu^{(65)}(\gamma,n)Cu^{(64)}$	−9.91	11	βtron	13^hCu	56B47
$Cu^{65}(p,n)Zn^{65}$	−2.136	4	VdG	thresh n	55B116
$Cu^{65}(p,n)Zn^{65}$	−2.131	5	VdG	n res	55M81
$Zn^{(68)}(p,n)Ga^{(68)}$	−3.694	6	VdG	thresh n	55B116
$As^{75}(\gamma,n)As^{74}$	−10.14	10	βtron		56C48
$Kr^{78}(d,p)Kr^{79}$	5.9		cyc	ppl	56B53
$Kr^{80}(d,p)Kr^{81}$	5.1		cyc	ppl	56B53
$Sr^{86}(\gamma,n)Sr^{85}$	−11.5		βtron	BF_3	55Y08
$Y^{89}(\gamma,n)Y^{88}$	−11.72	7	βtron		56C48
$Zr^{(90)}(\gamma,n)Zr^{(89)}$	−11.78	9	βtron	4^mZr	56A08
$Nb^{93}(\gamma,n)Nb^{92}$	−8.72	6	βtron		56C48
$Rh^{103}(\gamma,n)Rh^{102}$	−9.39	10	βtron		56C48
$Ag^{(107)}(\gamma,n)Ag^{(106)}$	−9.46	5	βtron	24^mAg	56B47
$Ag^{(109)}(\gamma,n)Ag^{(108)}$	−9.18	5	βtron	2.3^mAg	56B47
$I^{127}(\gamma,n)I^{126}$	−9.11	6	βtron		56C48
$Cs^{133}(\gamma,n)Cs^{132}$	−9.03	6	βtron		56C48
$La^{(139)}(\gamma,n)La^{(138)}$	−8.89	6	βtron		56C48
$Pr^{141}(\gamma,n)Pr^{140}$	−9.42	6	βtron		56C48
$Sm^{(142)}(\gamma,n)Sm^{(143)}$	−9.6		βtron	9^mSm	56S66
$Sm^{(149)}(n,\gamma)Sm^{(150)}$	8.00	3	pile	sπ Cp	55A46
$Tb^{159}(\gamma,n)Tb^{158}$	−8.03	6	βtron		56C48
$Ho^{165}(\gamma,n)Ho^{164}$	−8.14	6	βtron		56C48
$Tm^{169}(\gamma,n)Tm^{168}$	−7.93	6	βtron		56C48
$Ta^{181}(\gamma,n)Ta^{180}$	−7.69	6	βtron		56C48
$Au^{197}(\gamma,n)Au^{196}$	−8.01	6	βtron		56C48
$Hg^{(199)}(n,\gamma)Hg^{(200)}$	8.03	3	pile	sπ Cp	55A46
$Bi^{209}(\gamma,n)Bi^{208}$	−7.40	5	βtron		56C48
$Bi^{209}(p,2n)Po^{208}$	−9.65	8	cyc	α Po^{208}	56A05

54K47 L.M.Khromchenko, Doklady Akad. Nauk. SSSR 98, 761 (1954).

54S107 E.Silva, Thesis, Univ. São Paulo (1954).

55A46 B.P.Adyasevich, B.D.Groshev, A.M.Demidov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy Phys. Math. Sci. p.270, July (1955); Consultants Bureau Trans. p.195.

55A50 E.A.Almqvist, R.L.Clarke, E.B.Paul, Phys. Rev. 100, 1265A (1955).

55B116 R.M.Brugger, T.W.Bonner, J.B.Marion, Phys. Rev. 100, 84 (1956); based on $Li^7(p,n)$ threshold = 1.8811 *5*.

55B127 W.W.Buechner, C.M.Braams, A.Sperduto, Phys. Rev. 100, 1387 (1955); based on Hρ(Po α) = 331,590.

55B147 C.P.Browne, M.I.T. Ann. Prog. Report, p.113 (1955).

55C45 R.Chiba, R.A.Douglas, J.W.Broer, D.F.Herring, E.A.Silverstein, Phys. Rev. 100, 1253A (1955); verbal report.

55D34 R.A.Douglas, J.W.Broer, R.Chiba, Phys. Rev. 100, 1253A (1955); Bull. Am. Phys. Soc. 1, No. 1, 21, DA13 (1956); verbal report.

55F15 W.J.Fader, M.I.T. Ann. Prog. Report, p.123 (1955).

55G54 J.H.Gibbons, R.L.Macklin, H.W.Schmitt, Phys. Rev. 100, 167 (1955); based on Li(p,n).

55K41 L.M.Khromchenko, V.A.Blinov, Soviet Phys. JETP 1, 596 (1955); Zhur. Eksptl' i Teoret. Fiz. 28, 741 (1955).

55M81 J.B.Marion, R.A.Chapman, Phys. Rev. 101, 283 (1956); 100, 1795A (1955); for standard see 55B116.

55M84 J.B.Marion, T.W.Bonner, C.F.Cook, Phys. Rev. 100, 91 (1955); for standard see 55B116.

55M85 J.B.Marion, R.M.Brugger, T.W.Bonner, Phys. Rev. 100, 46 (1955); for standard see 55B116.

55P46 C.H.Paris, W.W.Buechner, P.M.Endt, Phys. Rev. 100, 1317 (1955); for standard see 55B127.

55P50 R.T.Pauli, Arkiv Fysik 9, 571 (1955); based on $Q[C^{12}(d,p)]$ = 2.223 *6*, $Q[N^{14}(d,p)]$ = 3.339 *5* and 3.310 *5*.

55R40 F.L.Ribe, Phys. Rev. 100, 1254A (1955); verbal report.

55Y08 P.F.Yergin, B.P.Fabricand, Phys. Rev. 100, 1269A (1955).

56A05 C.G.Andre, J.R.Huizenga, J.F.Mech, W.J.Ramler, E.Rauh, S.R.Rocklin, Phys. Rev. 101, 645 (1956); 93, 925A (1955).

56A08 P.Axel, J.D.Fox, Phys. Rev. 102, 400 (1956); based on $Q[Cu^{63}(\gamma,n)]$ = 10.73 *5* and $Q[O^{16}(\gamma,n)]$ = 15.605 *12*. Observed threshold for ^{4m}Zr = 12.37 ±0.09. Energy of ITγ = 0.59.

56A14 S.K.Allison, P.G.Murphy, E.Norbeck, Jr., Phys. Rev. 102, 1182 (1956); based on $Q[B^{10}(d,p_1)]$ = 7.097 *9*.

56A22 F.Ajzenberg-Selove, G.D.Johnson, A.Rubin, M. Mazari, Phys. Rev. 103, 356 (1956).

56B13 W.W.Buechner, M.Mazori, A.Sperduto, Phys. Rev. 101, 188 (1956); based on Hρ(Po α) = 331,590.

56B22 J.W.Butler, Bull. Am. Phys. Soc. 1, No. 2, 94, M8 (1956); based on $Li^7(p,n)$ threshold = 1.881 and $Al^{27}(p,\gamma)$ resonance at 0.9933.

56B23 H.Bichsel, T.W.Bonner, Bull. Am. Phys. Soc. 1, No. 2. 93, M5 (1956); for standard see 55B116.

56B37 D.A.Bromley, H.E.Gove, A.E.Litherland, E.B. Paul, E.Almqvist, Bull. Am. Phys. Soc. 1, No. 4, 195, N2 (1956); verbal report.

56B47 W.L.Bendel, J.McElhinney, R.A.Tobin, Bull. Am. Phys. Soc. 1, No. 4, 192, M7 (1956); verbal report; based on (γ,n) thresholds of H^2, F^{19}, O^{16} found from Wapstra's mass values.

56B51 B.S.Burton, R.M.Williamson, Bull. Am. Phys. Soc. 1, No. 5, 264 F3 (1956); verbal report; based on $Li^7(p,n)$ threshold = 1.8811 *5*.

56B52 C.K.Bockelman, A.Lévêque, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 6, 280 B1 (1956).

56B53 N.C.Blais, W.W.Watson, Bull. Am. Phys. Soc. 1, No. 6, 281 B9 (1956).

56B106 R.Barjon, D.Magnac-Valette, J.Schmouker quoted by D.Magnac-Valette, Compt. rend. 242, 760 (1956).

56B108 C.M.Braams, Thesis, Univ. of Utrecht (1956); for standard see 55B127.

56B109 C.M.Braams, Phys. Rev. 103, 1310 (1956); for standard see 55B127.

56C04 P.J.Campion, G.A.Bartholomew, Bull. Am. Phys. Soc. 1, No. 1, 28, GA2 (1956); verbal report.

56C20 G.B.Chadwick, T.K.Alexander, J.B.Warren, Can. J. Phys. 34, 381 (1956); based on $F^{19}(p,\alpha\gamma)$ resonances and 2.62, 6.13, 9.17 γ's from ThC'', $F^{19}(p,\alpha\gamma)$, $C^{13}(p,\gamma)$ respectively.

56C48 B.G.Chidley, L.Katz, priv. comm. (1956).

56D47 W.T.Doyle, A.B.Robins, Phys. Rev. 101, 1056 (1956); 98, 1185A (1955).

56E07 A.J.Elwyn, F.B.Shull, Bull. Am. Phys. Soc. 1, No. 6, 281 B7 (1956).

56E09 F.A.El Bedewi, Proc. Phys. Soc. 69A, 221 (1956); based on $C^{12}(d,p)$.

56E12 P.M.Endt, C.H.Paris, A.Sperduto, W.W.Buechner, Phys. Rev. 103, 961 (1956); Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956); for standard see 55B127.

56F10 W.A.Fowler, C.W.Cook, C.C.Lauritsen, T.Lauritsen, F.Mozer, Bull. Am. Phys. Soc. 1, No. 4, 191, M2 (1956); verbal report.

56G03 C.R.Gosset, J.W.Butler, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 1, 40, JA5 (1956); verbal report; for standard see 56B22.

56G28 H.G.Graetzer, A.B.Robbins, Bull. Am. Phys. Soc. 1, No. 6, 280 B2 (1956); based on $Q[Al^{27}(p,\alpha)]$ = 1.594 *2*.

56H34 F.L.Hassler, F.E.Steigert, G.F.Pieper, Bull. Am. Phys. Soc. 1, No. 6, 280 B4 (1956).

56J01 N.Jarmie, Bull. Am. Phys. Soc. 1, No. 1, 28, GA4 (1956).

56J02 R.Johnston, H.D.Holmgren, Bull. Am. Phys. Soc. 1, No. 1, 21, DA9 (1956); verbal report; for standard see 56B22.

56J12 C.H.Johnson quoted by R.A.Chapman, J.B.Marion, J.C.Slattery, Bull. Am. Phys. Soc. 1, No. 2, 95, N3 (1956).

56L14 L.L.Lee, Jr., F.P.Mooring, Bull. Am. Phys. Soc. 1, No. 6, 281 B8 (1956).

56M18 H.Mark, C.Goodman, Phys. Rev. 101, 768 (1956); based on $Li^7(p,n)$ threshold = 1.8814 *11*.

56N04 I.Nonaka, S.Morita, N.Kawai, T.Ishimatsu, S.Suematsu, K.Takeshita, Y.Nakajima, Y.Wakuda, J. Phys. Soc. Japan, 11, 1 (1956).

56P06 G.F.Pieper, G.S.Stanford, Phys. Rev. 101, 672 (1956); based on $Q[Al^{27}(\alpha,p)]$ = 2.39 *1*.

56Q01 A.R.Quinton, W.T.Doyle, Phys. Rev. 101, 669 (1956).

56R06 A.B.Robbins, Phys. Rev. 101, 1373 (1956); 100, 1549A (1955).

56R38 Robinson, McPherson, Greensberg, L.Katz, R.N.H. Haslam, priv. comm. (1956); based on $N^{14}(\gamma,n)$ threshold = 10.545 and $F^{19}(\gamma,n)$ threshold = 10.41; also quoted by A.M.Penfold, B.M.Spicer, Phys. Rev. 104, 1377 (1956).

56S20 P.B.Schwartz, J.W.Corbett, W.W.Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955); based on $Q[N^{14}(\alpha,p)]$ = −1.198 from masses.

56S31 A.Sperduto, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 4, 223, W4 (1956); for standard see 55B127.

56S57 M.J.Scott, R.E.Segel, Phys. Rev. 102, 1557 (1956).

56S66 E.Silva, J.Goldemberg, Nuovo Cim. 3, 12 (1956).

56S81 C.S.Stanford, G.F.Pieper, Phys. Rev. 103, 637 (1956).

56V14 D.M.Van Patter, C.P.Swann, W.C.Porter, C.E. Mandeville, Phys. Rev. 103, 656 (1956); Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956); based on Hρ(Po α) = 331650 *60*, $Q[Al^{27}(p,\alpha)]$ = 1.594 *2*, $Li(p,n)$ threshold = 1.8811 *5*, $Q[Al^{27}(p,p')]$, and $Q[P^{31}(p,p')]$.

56W03 J.B.Warren, T.K.Alexander, G.B.Chadwick, Phys. Rev. 101, 242 (1956).

4. MASS DIFFERENCES

Where no superscripts have been used with H, C, and O, the weights of the most abundant isotopes, namely 1, 12 and 16 respectively, are to be understood. Differences are given in millimass units.

	Value		Ref.
$C_4H_8O_2 - C_4H_7O_2$	+1008.16	2	56S45
$H^2 - H_2$	−1.5483	10	56D34
$N^{14}H^2H - N^{14}H_3$	−1.5478	4	56Q02
$H^2O - H_2O$	−1.5476	5	56Q02
$H_2^2 - He^4$	+25.600	2	56D34
$2H_3^2 - C$	+84.596	14	56D34
$H_2^2O - H_2O^{18}$	+8.3102	4	56Q02, 56S45
$HH^2O - F^{19}$	+18.4380	14	56S45
$H_2^2O - HF^{19}$	+16.8944	5	56S45
$H_2^2O - Ne^{20}$	+30.6872	7	56Q02, 56S45
$HH^2O^{18} - Ne^{21}$	+27.2482	7	56S45
$2H_2^2O - A^{40}$	+83.8780	20	56Q02
$He^4 - H_2^2$	−25.600	2	56D34
$B^{10}F_2^{19} - S^{32}O$	+42.7730	17	56S45
$B^{10}H - B^{11}$	+11.450	12	56L27
$B^{10}B^{11}H_2 - Na^{23}$	+48.130	10	56L27
$B^{11}H - C$	+17.139	7	56L27
$B^{11}F_3^{19} - C_4H_4O$	−21.7052	13	56S45
$CH_4 - O$	+36.3931	9	56Q02
	+36.388	4	56D34
$C_2H_4 - CO$	+36.3934	8	56Q02
$C_3H_8 - CO_2$	+72.7870	16	56Q02
$C^{13} - C$	+1003.680	20	56R03
$C^{13}H_4 - HO$	+31.943	11	56K14
	+31.9253	7	56S45
$N^{14} - CH_2$	−12.5803	4	56Q02, 56S45
$N^{14}H_2 - CH_4$	−12.5803	4	56Q02, 56S45
$N_2^{14} - C_2H_4$	−25.1585	6	56Q02, 56S45
$N^{14}H_2 - O$	+23.8164	5	56Q02, 56S45
$N^{14}H_3 - HO$	+23.833	8	56K14
	+23.8159	6	56Q02, 56S45
$N_2^{14} - CO$	+11.2441	19	56M23, 55O08
	+11.2353	7	56Q02
	+11.2355	6	56S45
$N^{15} - CH_3$	−23.3652	9	56S45
$N^{15}H_3 - H_2O$	+13.019	5	56K14
	+13.0234	4	56S45

	Value		Ref.
$20^{17}O - C_4H_2O$	−22.448	18	56K14
$O^{17} - HO$	−3.6077	5	56S45
$H_2O^{17} - H_3O$	−3.601	6	56K14
$O^{18} - O$	+2004.875	25	56R03
$O^{18} - H_2O$	−11.4033	21	56Q02, 56S45
$HO^{18} - H_3O$	−11.405	8	56K14
$H_2O^{18} - H_2^2O$	−8.3102	4	56Q02, 56S45
$20^{18}O - C_4H_4O$	−38.080	26	56K14
	−38.0734	16	56Q02, 56S45
$H_2O^{18} - HF^{19}$	+8.582	2	56K14
$H_2O^{18} - Ne^{20}$	+22.392	5	56K14
	+22.3770	6	56Q02, 56S45
$HH^2O^{18} - Ne^{21}$	+27.2482	7	56S45
$CO O^{18} - 2Na^{23}$	+14.5184	40	56S45
$CF_3^{19} - C_3H_9$	−75.2462	20	56S45
$Si^{28}F_3^{19} - C_6H_{13}$	−129.625	4	56S45
$Si^{29}F_3^{19} - C_6H_{14}$	−137.889	7	56S45
$F^{19} - HH^2O$	−18.4380	14	56S45
$HF^{19} - H_2^2O$	−16.8944	5	56S45
$B^{11}F_3^{19} - C_4H_4O$	−21.7052	13	56S45
$Si^{30}F_3^{19} - C_4H_7O_2$	−75.6590	36	56S45
$HF^{19} - H_2O^{18}$	−8.582	2	56K14
$B^{10}F_2^{19} - S^{32}O$	+42.7730	17	56S45
$Ne^{20} - H_2^2O$	−30.6872	7	56Q02, 56S45
$Ne^{20} - H_2O^{18}$	−22.392	5	56K14
	−22.3770	6	56Q02, 56S45
$2Ne^{21} - C_2H_2O$	−22.858	10	56K14
$Ne^{21} - HH^2O^{18}$	−27.2482	7	56S45
$2Ne^{22} - CO_2$	−7.042	24	56K14
	−7.0614	12	56S45
$Na^{23} - B^{10}B^{11}H_2$	−48.130	10	56L27
$2Na^{23} - CO O^{18}$	−14.5184	40	56S45
$Mg^{24} - C_2$	−14.9621	11	56S45
$Mg^{25} - C_2H$	−21.9944	10	56S45
$Mg^{26} - C_2H_2$	−33.0676	10	56S45
$Al^{27} - C_2H_3$	−41.9548	23	56S45
$Si^{28}F_3^{19} - C_6H_{13}$	−129.625	4	56S45
$Si^{29}F_3^{19} - C_6H_{14}$	−137.889	7	56S45
$Si^{30}F_3^{19} - C_4H_7O_2$	−75.6590	36	56S45

	Value		Ref.
$S^{32}O - C_4$	−33.0269	*13*	56Q02
$S^{32} - O_2$	−17.7599	*9*	56Q02
	−17.756	*10*	56S26
$2H^2S^{32} - C_4H_4O$	−50.7852	*18*	56Q02
$S^{32}O - B^{10}F_2^{19}$	−42.7730	*17*	56S45
$S^{32}O_2 - Zn^{64}$	−32.7687	*32*	56Q02
$S^{33} - HS^{32}$	−8.448	*25*	56S26
$H_2S^{34} - C_3$	−16.466	*10*	56S26
$S^{34} - H_2S^{32}$	−19.851	*10*	56S26
$A^{36} - C_3$	−32.4729	*20*	56Q02
$A^{36} - 2H_2O$	−53.5874	*12*	56Q02
$A^{40} - C_3H_4$	−68.9344	*13*	56Q02
$A^{40} - 2H_2^2O$	−83.8780	*26*	56Q02
$K^{39} - C_3H_3$	−59.762	*20*	56L27
$K^{41} - C_3H_5$	−77.331	*20*	56L27
$Ni^{58} - C_3H_6O$	−106.52	*15*	56E10
	−107.0*	*2*	56I03
$Ni^{60} - C_2H_4O_2$	−90.82	*15*	56E10
$Zn^{64} - 2O_2$	−50.90	*30*	55K42
	−50.5266	*52*	56Q02
$Zn^{64} - S^{32}O_2$	−32.7687	*32*	56Q02
$2Zn^{66} - Xe^{132}$	−51.22	*30*	55K42
	−51.0*	*4*	56I03
$2Zn^{67} - Xe^{134}$	−50.50	*40*	55K42
$2Zn^{68} - Xe^{136}$	−54.40	*40*	55K42
$Xe^{132} - 2Zn^{66}$	+51.22	*30*	55K42
	+51.0*	*4*	56I03
$Xe^{134} - 2Zn^{67}$	+50.50	*40*	55K42
$Xe^{136} - 2Zn^{68}$	+54.40	*40*	55K42

*Dependence on gas pressure in spectrograph studied. Values listed here are for lowest pressure.

Some recent mass spectrometer masses compared with masses calculated from Q values by Wapstra (55W47)

	Value		Ref.
H^1	1.0081442	2 mass units	56Q02
	1.0081459	*5*	54M37
	1.008142	*1*	56D34
	1.0081452	*15*	55W47
H^2	2.0147406	*6*	56Q02
	2.0147444	*9*	54M37
	2.014736	*2*	56D34
	2.0147403	*28*	55W47
He^4	4.0038797	*16*	54M37
	4.003872	*4*	56D34
	4.0038739	*26*	55W47
C^{12}	12.0038167	*8*	56Q02
	12.0038231	*33*	54M37
	12.003820	*5*	56D34
	12.003803	*5*	55W47
S^{32}	31.9822401	*9*	56Q02
	31.982196	*26*	55W47

54M37 J.Mattauch, R.Bieri, Z. Naturf. 9a, 303 (1954).

55K42 J.T.Kerr, N.R.Isenor, H.E.Duckworth, Z. Naturf. 10a, 840 (1955).

55O08 K.Ogata, H.Matsuda, Z. Naturf. 10a, 843 (1955).

55W47 A.H.Wapstra, Physica 21, 367 (1955).

56D34 R.A.Demirkhanov, T.I.Gutkin, V.V.Dorokhov, A.D. Rudenko, J. Nuclear Energy 3, 251 (1956); Soviet Journal of Atomic Energy 1, No. 2, 21 (1956).

56E10 P.C.Eastman, N.R.Isenor, G.R.Bainbridge, H.E. Duckworth, Phys. Rev. 103, 145 (1956).

56I03 N.R.Isenor, G.R.Bainbridge, P.C.Eastman, H.E. Duckworth, Can. J. Phys. 34, 993 (1956).

56K14 M.E.Kettner, Phys. Rev. 102, 1065 (1956).

56L27 H.Liebl, H.Ewald, Z. Naturf. 11a, 406 (1956).

56M23 H.Matsuda, J. Phys. Soc. Japan 11, 183 (1956).

56Q02 K.S.Quisenberry, T.T.Scolman, A.O.Nier, Phys. Rev. 102, 1071 (1956); 100, 1245A (1955).

56R03 B.Rosenblum, A.H.Nethercot,Jr., Bull. Am. Phys. Soc. 1, No. 1, 13 BA8 (1956); verbal report.

56S26 G. v. Schierstedt, H.Ewald, H.Liebl, G.Sauermann, Z. Naturf. 11a, 216 (1956).

56S45 T.T.Scolman, K.S.Quisenberry, A.O.Nier, Phys. Rev. 102, 1076 (1956).

5. NUCLEAR SPINS AND MOMENTS

Listed here in tabular form are the nuclear spins and moments which are also reported, often in a more detailed manner, in Table 1. Spins, J, are given in units of $h/2\pi$; magnetic dipole moments, μ, in nuclear magnetons; electric quadrupole moments, q, in barns; magnetic octopole moments, μ_3, in nuclear magneton barns; electric 16-pole moments, q_4, in 10^{-48} cm^4.

Magnetic moments are reported without diamagnetic correction and where relative measurements have been made are based on $\mu(H) = +2.79267$ and the substandards listed by H. Walchli, ORNL-1469. The spins and moments are those for the ground states of the nuclei unless the particular level is specified. When the sign of the moment cannot be determined by the experimental method used, measured values are given between absolute value signs, e.g. $|1.1774\ 2|$.

ABBREVIATIONS

calc	value obtained from reevaluation of old data
$\gamma(\theta,T)$	γ intensity as function of angle and temperature
$\gamma\gamma(\theta,H)$	$\gamma\gamma$ coincidences as a function of angle and magnetic field
I	nuclear induction, magnetic resonance
M	molecular or atomic beam resonance
Mic	microwave
para	paramagnetic resonance
$p\gamma(\theta,H)$	$p\gamma$ coincidences as a function of angle and magnetic field
q res	quadrupole resonance
S	atomic spectra

	J	μ	q	Method	Ref.
n^1		−1.913138 *45*		M	56C02
H^1		+2.79268 *10*		deceler.cyc	56T19
Be^9	3/2	|1.1774 2|		I	56B48
F^{19}(0.197 level)		+3.0 *7*		$\gamma\gamma(\theta,H)$	56S78
		+3.50 *24*		$\gamma\gamma(\theta,H)$	56P30
		+3.70 *45*		$p,\gamma(\theta,H)$	56L22
		+3.4 *9*		$\gamma\gamma(\theta,H)$	55T25
Al^{27}	5/2	|3.6385 *3*|		I	56B48
V^{51}			+0.28 *15*	S	56M36
Co^{56}	4	|3.848 *15*|		para	56B69
	4	|3.855 *7*|		para	56J06
		|2.6 2|		$\gamma(\theta,T)$	56S13
Co^{57}	7/2	|4.65 *5*|		para	56B69
Co^{60}		positive		see ref.	55W42
	5	|3.800 *7*|		para	56D46
As^{75}		+1.45 *15*	+0.32 *5*	S	52M64
Kr^{83}	9/2		+0.22 2	S	55R46
Rb^{81}(31^m level)					
	9/2			M	56S70
Rb^{81}	3/2			M	56S71
Rb^{82}(0.24 level)					
	5			M	56S71
Rb^{83}	5/2			M	56S71
Rb^{84}	2			M	56S71
Rb^{85}			+0.27 2	M	56S59
Rb^{87}			+0.14 *6*	S	56K16
			+0.13 *1*	M	56S59
Zr^{91}		−1.9 2		S	55M88
Mo^{95}	5/2			para	56O04
	7/2			S	55M88
Mo^{97}	5/2			para	56O04
	7/2			S	55M88
Ru^{99}	5/2	−0.63 *15*		S	55M78
Ru^{101}	5/2	−0.69 *15*		S	55M78
Cd^{111}(0.247 level)					
		−0.783 *23*		$\gamma\gamma(\theta,H)$	56S63
In^{114}	5	+4.7 *5*		M	55G46
In^{115}		$\|\mu_3\|$ = 0.31 *1*		calc M	55S89
In^{116}(54^m level)					
	5	+4.21 *8*		M	56N12
	5	+4.4 *4*		M	55G56
I^{127}		$\|\mu_3\|$ = 0.17 *3*		calc M	55S89
Ba^{135}		+0.832293 *25*		I	56W20
Ba^{137}		+0.931074 *55*		I	56W20
La^{139}			+0.3 *1*	S	55L59
			+0.6 2	S	55M79
Pr^{141}	5/2	|3.9 2|		para	55B108
		+4.0 *1*	0.0 2	S	54M100
Nd^{147}	9/2	|0.22 *5*|		$\gamma(\theta,T)$	56A04
Sm^{147}		|0.83 *15*|	|<0.72|	calc para	53E19
Sm^{149}		|0.68 *10*|	|<0.72|	calc para	53E19
Gd^{155}	3/2	−0.30 *4*	+1.1 *3*	S	56S21
Gd^{157}	3/2	−0.37 *4*	+1.0 *3*	S	56S21
Dy^{161}	5/2	|0.38 *5*|		para	56C21
	3/2	μ^{163}/μ^{161} = 1.07 *5*		S	56M41
		$q^{163}/q^{161} \sim 1$		S	56M41
Dy^{163}	5/2	|0.53 *5*|		para	56C21
	3/2			S	56M41
Ho^{165}	7/2	|3.29 *17*|	|~2|	para	55B104
		μ and q have same sign			55B104

	J	μ	q	Method	Ref.
Er^{167}		|0.50 12|	| 10 2|	calc para	53E19
Tm^{169}	1/2	−0.205 20		S	55L49
Yb^{171}	1/2	|0.43 5|		para	56C21
		+0.49 6		S	55K33
Yb^{173}	5/2	|0.60 5|		para	56C21
	5/2	−0.67 1		S	55K33
Hf^{177}	7/2	+0.61 3	+3 1	S	56S53
Hf^{179}	9/2	−0.47 3	+3 1	S	56S53
Ta^{181}(0.480 level)					
	5/2	+3.25 17	$\gamma\gamma(\theta)$; $\gamma\gamma(\theta,H)$		55H69
Au^{198}	2	|0.50 4|		M	56C08
Au^{199}	3/2	|0.24 2|		M	56C08
Hg^{199}(0.159 level)			|0.70 $^{+40}_{-15}$|	$\gamma\gamma(\theta)$	56P14
Po^{209}	1/2			S	56V16
U^{233}	5/2	$\mu^{233}/\mu^{235} \sim -1.5$		S	55K36
	5/2	$\mu^{233}/\mu^{235} = -1.8$ 1		S	55K40
			$q^{233}/q^{235} = +2.0$ 3	S	55K40
U^{235}	5/2(7/2?)			S	55K40
	7/2	|0.38 or 0.31|		para	56H26
Pu^{239}	1/2			S	55K36
	1/2			S	55K40
Am^{241}		+1.4	+4.9	S	56M31
	5/2		large	S	56T18
Am^{243}		+1.4	+4.9	S	56M31

52M64 K.Murakawa, S.Suwa, Rept. Inst. Sci. Technol. Univ. Tokyo 6, 209 (1952).

53E19 R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

54M100 K.Murakawa, J. Phys. Soc. Japan 9, 93 (1954).

55B104 J.M.Baker, B.Bleaney, Proc. Phys. Soc. 68A, 1090 (1955).

55B108 J.M.Baker, B.Bleaney, Proc. Phys. Soc. 68A, 936 (1955).

55G46 L.S.Goodman, S.Wexler, Phys. Rev. 100, 1245A (1955); verbal report.

55G56 L.S.Goodman, S.Wexler, Phys. Rev. 100, 1796A (1955); verbal report.

55H69 E.Heer, R.Rüetschi, F.Scherrer, Z. Naturf. 10a, 834 (1955); Helv. Phys. Acta 28, 336A (1955).

55K33 K.Krebs. H.Nelkowski, Z. Phys. 141, 254 (1955).

55K36 L.A.Korostyleva, A.R.Striganov, N.M.Iashin, Zhur. Eksptl'i Teoret. Fiz. 28, 471 (1955); Soviet Phys. JETP 1, 310 (1955); Ivest. Akad. Nauk. Ser. Fiz. SSSR 19, 31 (1955).

55K40 N.I.Kaliteevskii, M.P.Chaika, Doklady Akad. Nauk SSSR 103, 49 (1955).

55L49 K.H.Lindenberger, Z. Phys. 141, 476 (1955); Naturwiss. 42, 41 (1955).

55L59 G.Lührs. Z. Phys. 191, 486 (1955).

55M78 K.Murakawa, J. Phys. Soc. Japan 10, 919 (1955); 9, 427, 651 (1954); from $\bar{\mu}$(for A = 99,101) = −0.66 ± 2 and μ_{101}/μ_{99} = 1.09 ± 3 of Griffiths, Owen, Proc. Phys. Soc. 65A, 951 (1952).

55M79 K.Murakawa, J. Phys. Soc. Japan 10, 927 (1955); Phys. Rev. 98, 1285 (1955).

55M88 K.Murakawa, Phys. Rev. 100, 1369 (1955).

55R46 E.Rasmussen, V.Middelboe, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 13 (1955).

55S89 C.Schwartz, Phys. Rev. 97, 380 (1955).

55T25 P.B.Treacy, Nature 176, 923 (1955).

55W42 J.C.Wheatley, W.J.Huiskamp, A.N.Diddens, N.J. Steenland, H.A.Tolhoek, Physica 21, 841 (1955); from circular polarization of γ's from polarized Co^{60}

56A04 E.Ambler, R.P.Hudson, G.M.Temmer, Phys. Rev. 101, 196 (1956); 97, 1212; 98, 230A (1955).

56B48 L.C.Brown, D.Williams, J. Chem. Phys. 24, 751 (1956).

56B69 J.M.Baker, B.Bleaney, P.M.Llewellyn, P.F.D. Shaw, Proc. Phys. Soc. 69A, 353 (1956).

56C02 N.R.Corngold, V.W.Cohen, N.F.Ramsey, Bull. Am. Phys. Soc. 1, No. 1, 11, B7 (1956).

56C08 R.L.Christensen, D.R.Hamilton, A.Lemonick, F.M.Pipkin, J.B.Reynolds, H.H.Stroke, Phys. Rev. 101, 1389 (1956); 99, 613A (1955).

56C21 A.H.Cooke, J.G.Park, Proc. Phys. Soc. 69A, 282 (1956); if g.s. of Dy^{+++} ion in crystal is $^6H_{15/2}$.

56D46 W.Dobrowolski, R.V.Jones, C.D.Jeffries, Phys. Rev. 101, 1001 (1956).

56H26 C.A.Hutchison,Jr., P.M.Llewellyn, E.Wong, P.Dorain, Phys. Rev. 102, 292 (1956).

56J06 R.V.Jones, W.Dobrowolski, C.D.Jeffries, Phys. Rev. 102, 738 (1956).

56K16 H.Kopfermann, A.Steudel, J.O.Trier, Z. Phys. 144, 9 (1956).

56L22 P.Lehmann, A.Lévêque, M.Fiehrer, R.Pick, J. phys. radium 17, 560 (1956); Phys. Rev. 104, 411 (1956); Compt. rend. 241, 700 (1955).

56M31 T.E.Manning, M.Fred, F.S.Tomkins, Phys. Rev. 102, 1108 (1956).

56M36 K.Murakawa, J. Phys. Soc. Japan 11, 422 (1956).

56M41 K.Murakawa, J. Phys. Soc. Japan 11, 804 (1956); Phys. Rev. 92, 325 (1953).

56N12 P.B.Nutter, Phil. Mag. 1, 587 (1956).

56O04 J.Owen, I.M.Ward, Phys. Rev. 102, 591 (1956).

56P14 R.V.Pound, G.K.Wertheim, Phys. Rev. 102, 396 (1956); using $q(Hg^{201}) = 0.45$.

56P30 W.R.Phillips, G.A.Jones, Phil. Mag. 1, 576 (1956).

56S13 R.C.Sapp, C.M.Schroeder, Bull. Am. Phys. Soc. 1, No. 2, 91 L1 (1956); from $|g| = 0.66 \pm 4$.

56S21 D.R.Speck, Phys. Rev. 101, 1725 (1956); 100, 973A (1955).

56S53 D.R.Speck, F.A.Jenkins, Phys. Rev. 101, 1831 (1956); Bull. Am. Phys. Soc. 1, No. 6, 282 C3 (1956).

56S59 B.Senitzky, I.J.Rabi, Phys. Rev. 103, 315 (1956); 98, 1537A (1955).

56S63 R.M.Steffen, W.Zobel, Phys. Rev. 103, 126 (1956); method independent of quadrupole interaction.

56S70 H.A.Shugart, J.C.Hubbs, E.Lipworth, W.A. Nierenberg, H.B.Silsbee, Bull. Am. Phys. Soc. 1, No. 5, 253 F5 (1956); Phys. Rev. 104, 757 (1956).

56S71 R.Sunderland, J.C.Hubbs, W.A.Nierenberg, H.B. Silsbee, J.P.Hobson, Bull. Am. Phys. Soc. 1, No. 5, 252 F4 (1956); Phys. Rev. 104, 101 (1956).

56S78 K.Sugimoto, A.Mizobuchi, Phys. Rev. 103, 739 (1956).

56T18 R.Thorne, Nature 178, 484 (1956).

56T19 K.R.Trigger, Bull. Am. Phys. Soc. 1, No. 4, 220 UA8 (1956); priv. comm.; without diamagnetic correction.

56V16 K.L.Vander Sluis, P.M.Griffin, J. Opt. Soc. Am. 45, 1087 (1955).

56W20 H.E.Walchli, T.J.Rowland, Phys. Rev. 102, 1334 (1956).

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